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AMBLYCORYPHA OBLONGIFOLIA

PINK KATYDID. (See page 351.)

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THE ORTHOPTERA OF INDIANA.

From the 27th Annual Report of the Department of Geology and
Natural Resources of Indiana, 1902.

Author's Separates issued September 5, 1903.

(1140 - Stanley)
BY W. S. BLATCHLEY,
Indianapolis, Ind.



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THE ORTHOPTERA OF INDIANA.

AN ILLUSTRATED DESCRIPTIVE CATALOGUE OF THE SPECIES KNOWN
TO OCCUR IN THE STATE, WITH BIBLIOGRAPHY, SYNONYMY
AND DESCRIPTIONS OF NEW SPECIES.

(Willis Stanley)
BY W. S. BLATCHLEY,
Indianapolis, Ind.

INTRODUCTORY.

One August evening in 1901 I was seated in the lobby of the St. George Hotel, at Evansville, Indiana, when a large "lubberly locust"—*Melanoplus differentialis* Thos.—attracted by the light, flew into the room. Several of the guests, men of intelligence, saw me pick it up, and immediately surrounded me and asked me what it was. I told them that it was a locust or grasshopper, and that fifty or more species of the same family of insects occur in Indiana. All seemed much surprised and a number of them made the statement that they thought there was but one kind of grasshopper in the State. Such is the opinion of most persons who pay little or no attention to the forms of animal and plant life which surround them. Verily, the most common things about us are those of which we know the least.

For eighteen years I have been more or less interested in that group of insects known as the *Orthoptera*. During that time I have collected them in the different parts of the State which I have visited and have made many notes upon their habits and their distribution. This information I have concluded to bring together into a form suitable for the use of the student in the public schools of the State, or for the boys and girls on the farms, who daily come in contact with some of these interesting insects. While the information which they will gain from the study of such a group may not be of great monetary value, i. e., may not add many "almighty dollars" to the future wealth of the student, it will add to his powers of observation, upon which much of his future knowledge will depend. It may serve to bring him in closer contact with nature, and teach him something of the mutual relationships existing between all of her objects, himself included.

The first thing which any one asks concerning a bird, an insect or a stone, is "What is it?" It must have a name—a handle—to hold it by, while we talk of its habits, the benefits or injuries which it does, the means for its protection or extermination. Each of the insects treated in this paper has a double Latin name by which it is or may be known to students of the *Orthoptera* in all parts of the world. In order that the student may determine this name for himself, "keys" or "tables of determination" have been inserted, which, if carefully followed and compared with the different characters of the insect in hand, will lead up to its scientific name. The common name by which it is generally known is also added, but the common name varies greatly in different localities.

ACKNOWLEDGMENTS.—During my study of the Orthoptera and in the preparation of the present paper I have been greatly aided by that nestor of orthopterological students, Mr. S. H. Scudder, of Cambridge, Massachusetts. To him, more than to all others combined, is due our present knowledge of the classification and distribution of North American Orthoptera. Always willing to answer questions and ever interested in any new form which was discovered, his counsel has been to me both inspiring and helpful. His many works upon the subject have been freely used in preparing the present paper. Profs. Lawrence Bruner, of Lincoln, Nebraska, and A. 1 Morse, of Wellesley, Massachusetts, who, next to Mr. Scudder, are the leading authorities on the group, have also rendered me much aid in comparing and verifying specimens sent to them for examination. Only a person situated as I have been, far from any great reference collection, can duly appreciate such kindness as they have shown. To Dr. J. L. Hancock, of Chicago, and Mr. A. N. Caudell, of Washington, D. C., I am also indebted for favors shown; the former having passed in review the collection of Tettiginæ made in the State. Other acknowledgments are made in the body of the paper.

ILLUSTRATIONS.—The illustrations used have, for the most part, been taken from the late Prof. Otto Lugger's "Third Annual Report of the Entomologist of the State Experiment Station of the University of Minnesota;" permission to use them having been kindly granted by the present State Entomologist, Prof. F. L. Washburn. A number of original drawings have, however, been made expressly for the paper, by S. Fred Prince, of Lincoln, Nebraska, and Miss Lillian Howenstein, of the U. S. Department of Agriculture. The Secretary of the Smithsonian Institution has also kindly granted the use of the figures illustrating the abdominal appendages of the *Melanopli*, which are from Mr. Scudder's "Revision of the Orthopteron Group, *Melanopli*," published in Vol. XX, of the Proceedings of the U. S. National Museum.

THE EXTERNAL ANATOMY OF A LOCUST.

Before taking up the description and classification of the insects treated in this paper, it is thought best to describe briefly the external parts of a typical member of the order Orthoptera. The beginner may thus the more readily grasp the name and location of the parts used in classification, as well as the meaning of many of the technical terms which, of necessity, have to be used in such a paper.

If we compare the body of a locust or grasshopper with that of any vertebrate animal, as a fish, bird or squirrel, we find at once great

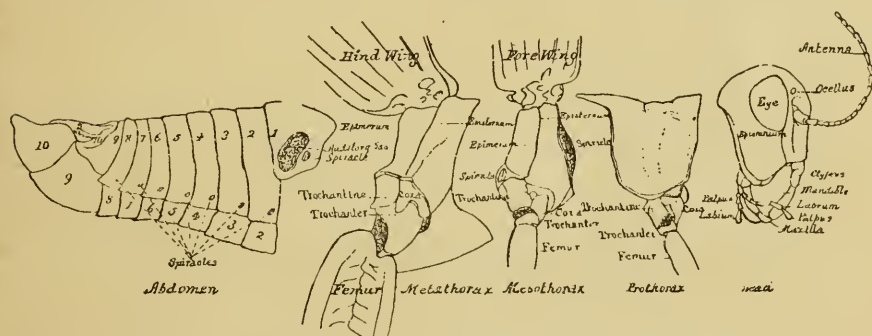


Fig. 2. Body of a locust, side view, showing the thorax separated from the head and abdomen, and divided into its three segments.
(After Packard.)

and important differences. The vertebrate is an animal with an inner bony skeleton, two pairs of jointed limbs or appendages, and breathes by means of lungs or gills, according as it dwells in air or water. The insect is an animal which has no inner skeleton or bones whatever, but only a hard crust on the surface which surrounds the muscles and vital organs. This crust is composed of separate rings, 17 in number, placed end to end. These rings, as well as the legs and wings attached to them, are composed of a cuticle or skin hardened by a substance called "chitin," which is secreted or exuded by the cells which compose the cuticle. Chitin itself is insoluble and is not composed of cells, but consists of fine, irregular plates. It hardens the cuticle and thus aids the latter in protecting

the delicate vital organs within, and also in forming a framework to which the muscles of movement may be attached. Between the joints the cuticle is devoid of chitin and is thin, delicate, and flexible, thus allowing the necessary freedom of motion.

The adults of insects, and in most cases, the young, have six true legs, and the former usually, though not always, have wings. Moreover, insects breathe by a system of tubes called trachea, which branch and ramify through every portion of the body, and which open externally in about ten places on each side of the body, instead of at the front end. A locust could, therefore, be held with its head beneath the water for an hour, without drowning it. In the true insects, the rings of the body are grouped in three regions; the head, the thorax, and the abdomen. In general, it may be said that the head contains or bears the organs of sense and of prehension and mastication of the food; the thorax the organs of locomotion; and the abdomen those of reproduction.

THE HEAD.

The head of the locust is composed of four or more segments or rings, solidly fused together into a capsule or hard box of chitin, known as the "*epicranium*," which contains the brain and associated ganglia, and the mouth. It bears or gives support to the antennæ, mouth parts, eyes and ocelli; also internally to the muscles moving the mandibles or jaws. The broad basal portion of the epicranium back of the eyes is known as the "*occiput*;" the narrower portion be-

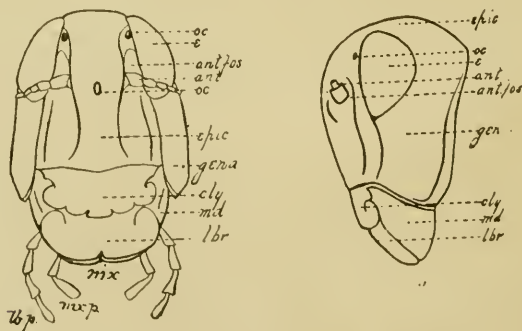


Fig. 3. (a) Front view of the head of a locust
(b) Lateral view of the head of a locust.
(After Lugger)

tween the eyes, the "*vertex*," while the long frontal portion as far down as the prominent transverse suture is the "*front*" or "*face*."

The short plate (*cly*), below or in front of the epicranium, is the "*clypeus*." Below this and hinged to its front edge is a movable flap known as the "*labrum* (*lbr*)" or upper lip, to which are attached a pair of jointed "*labial palpi*." This forms the roof or covering of the front part of the mouth, within which are the large, black-tipped, toothed jaws or "*mandibles*" (*md*), which are so attached to the epicranium as to move only in and out or to and from a median line. Beneath the labrum and arched over the tongue will also be found a

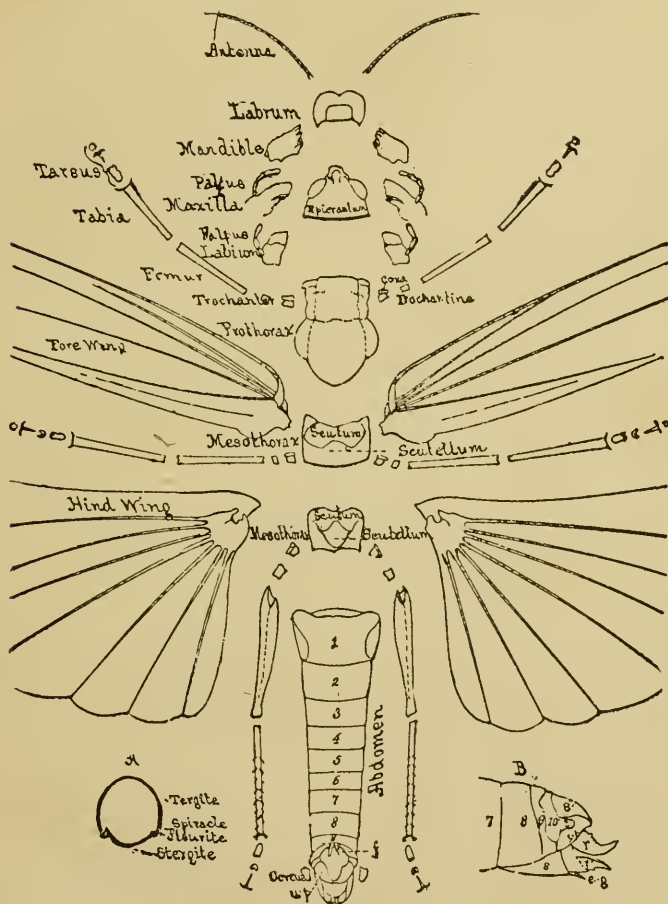


Fig. 4. External anatomy of a locust, showing the head and thorax disjointed.
(After Packard.)

pair of accessory jaws, the "*maxilla*" (*mx*), each of which is composed of three pieces, the most important, used in classification, being the jointed "*maxillary palpus*."

Above the clypeus, is a ridge extending upward along the median line of the face to the vertex. This is the "*frontal costa*;" and its characters are often used in classification. In one species it may be sulcate or grooved; in another, flat. Its edges, or "*carinae*" may be parallel the full length or may diverge or converge. Its width and prominence are also often mentioned.

The region on the side of the head, behind the eye, and above the base of the mandibles is the cheek or "*gena*" (*gen.*). To its inner wall is attached the large muscle which moves the mandible.

The eyes of a locust are five in number; two large compound ones, and three small, simple ones. The compound eyes are present in all Orthoptera. In the locust they vary in shape, but for the most part are oval, and are located on the upper portion of the sides of the head. Each is made up of many thousands of six-sided facets or lenses, in each of which a single filament of the optic nerve ends. The simple eyes or "*ocelli*?" (*oc.*) are absent in some Orthoptera, as the *Locustida*, but are present in the locust. Two of them are situated just above the base of the antennae close to the inner margins of the compound eyes; while the third is located near the middle of the frontal costa. Their position varies in the different families of Orthoptera. These ocelli are thought to be inherited from the obscure eyes of the worm-like ancestry of the locust, while the many faceted compound eyes of insects and crustaceans have been evolved to satisfy the needs of the more recent existence of these groups.

The *antennae* (*ant.*) of the locust are simple, many jointed appendages, located on the face between the eyes and articulating with the

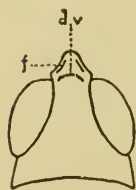


Fig. 5 Showing fastigium, disk and foveola of vertex.

(After Lugger.)

head by a ball and socket joint. They are principally organs of touch, but are also supposed to contain the nerves of smell. They vary much in length and form among the different families of Orthoptera, the variation being the result of adaptation to their peculiar surroundings and habits. For instance, in those *Locustidae* which dwell in caves they are very much longer than in those members of the same genus which dwell above ground. Characters pertaining to their form, length, and point of union with the head, are much used in classification.

Such terms as "filiform," "clavate," "setaceous," etc., relating to their form, are defined in the accompanying glossary.

Characters pertaining to the vertex, or that part of the epieranium between the eyes, are much used in separating the different species of Orthoptera. The central portion of the vertex, known as the "*disk*,"

(*dv.*) or "scutellum," (*sv.*) is often depressed, or separated from the remainder. Its bounding walls are termed "*lateral carinae*" and often a "*median carina*" divides it into two parts. The front portion, or apex, often called the "*fastigium*," is variable in form, and its characters are also much used. On the outer side of, and a little below the front half of each lateral carina of the vertex, there is, in many Orthoptera, a little space or concavity bounded by elevated ridges. These spaces are the "*lateral foveolae*," (*f.*) and their variations in size and form also afford characters much used in classification.

THE THORAX AND ITS APPENDAGES.

The middle region of the body is called the "*thorax*." To study its parts aright, the wings and legs attached to it should be removed; when it will be seen to consist of three rings or segments. These are known as the "*prothorax*," "*mesothorax*" and "*metathorax*." Within these rings are located the muscles for moving the wings and legs; as well as some of the digestive organs.

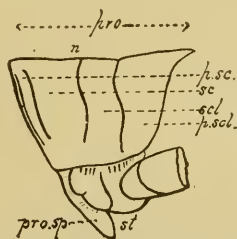


Fig. 6. Lateral view of the prothorax of a locust.
(After Lugger.)

THE PROTHORAX of the locust (Fig. 6) has its sides and dorsal surface covered by a large, sun-bonnet shaped piece known as the "pronotum" (*pro.*). This varies much in shape and size in the different families of Orthoptera. Its upper surface is called the "disk," and its sides, the "lateral lobes." Raised lines known as "*lateral carinae*" usually separate the disk from the sides, while a third line, the "*median carina*," runs lengthwise through the middle of the disk. This may be "high" or "low," "crested," "arched," "distinct," "aborted," etc. It is usually cut by one or more notches formed by shallow grooves or "*sulci*" which cross the disk of the pronotum and extend down its sides. The hindmost of these sulci, or grooves, divides the disk of the pronotum into two parts known as the "*prozona*" (*pz.*) and "*metazona*" (*mz.*). The fore and hind margins of the disk of pronotum may be "truncate," "rounded," "angled,"

"notched," etc. The surface of the disk is often smooth, but sometimes "wrinkled" and may be "rugose" or roughened with numerous tubercles.

The under or "ventral" side of the prothorax is a narrow, somewhat movable piece called the prosternum. On its center it often bears a tooth or spine (*pro sp.*), the presence or absence, and shape of which form characters used in classification. Near the outer ends of the prosternum are shallow sockets in which are attached the front pair of legs.

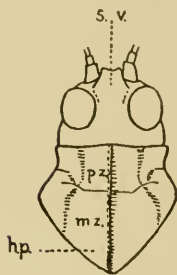


Fig. 7. Showing "prozona" and "metazona" of pronotum, and "scutellum" of vertex.
(After Lugger.)

THE MESOTHORAX and METATHORAX, the second and third segments of the thorax, are, in the locust, rather firmly united with the basal abdominal segment of the abdomen to form a firm walled box; though in the *Blattidæ* they are distinct. The upper portion of these segments is, in many Orthoptera, partly or wholly covered by the pronotum. To the mesothorax are attached the first or outer pair of wings and the second or middle pair of legs. To the metathorax are joined the inner wings and the third or hind pair of legs. The under or ventral portion of these segments are called respectively

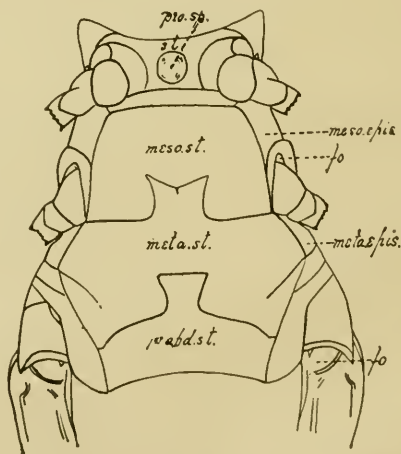


Fig. 8. Lower or ventral view of the thorax of a locust.
(After Lugger.)

the "mesosternum" and "metasternum." The former, in the locust, is composed of a front transverse portion, with two nearly rectangular lobes projecting backward. Between these lobes is dovetailed

a squarish tongue or forward prolongation of the metasternum. The latter is united with the basal abdominal segment by the dovetailing of a similar but narrower tongue between its lobes. The side pieces of the mesothorax and metathorax are called "pleurites" and bear the prefixes "meso" and "meta."

THE WINGS.—These are thin, broad, more or less leaf-like folds of the integument or body covering, which are joined to the thorax and moved by powerful muscles located within the thoracic cavity. The first or outer pair of wings of the locust and other Orthoptera serve as shields or covers for the more delicate inner pair. In the text which follows they are called "wing covers" or "tegmina." Each wing cover is a thin, more or less transparent, leathery or parchment-like plate of chitin; strengthened by a network of tubes called "nerves" or "veins." The spaces enclosed by the veins and their cross branches are called "cells." When folded and at rest upon the body the outer faces of the tegmina of a locust are vertical, with the front or costal margin below, and the posterior or sutural margin lying along the back; that of the left wing cover slightly overlapping the right.

The principal veins of the tegmina of a locust diverge from the basal end and are seven in number. The one nearest the front or lower margin of the wing cover is the "sub-marginal" or "costal

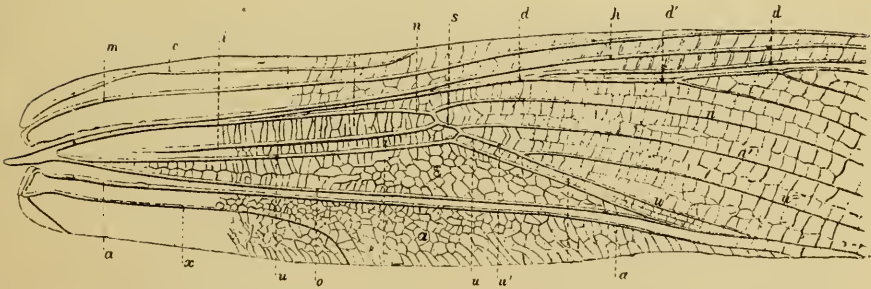


Fig. 9. Right tegmina of a locust, showing the venation. The names of the veins designated by the letters are given in the text.

(After Saussure.)

vein" (*c*). It is undivided, and may usually be traced for a little more than half the length of the tegmina, though in some locusts it is lacking. The second and longer vein, also undivided, is the "mediastinal" (*m*). The third and much larger vein is the "humeral" (*h*), sometimes called the "sub-costal." It gives rise to several large branches, the sub-divisions of which form the framework of the greater part of the wing cover. The larger of these branches

(*d*), is known as the "discoidal vein," its branches being designated as (*d'*, *d''*), etc. The fourth or "median vein" (*n*) is much smaller and soon divides into branches of nearly equal size. Above or behind the median vein is sometimes present a short, undivided vein

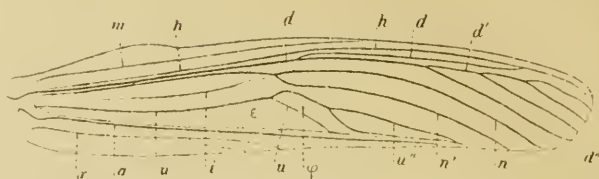


Fig. 10. Right tegmina of the locust, *Dissosteira carolina* (L.) Showing the venation.
(After Saussure.)

(*i*), known as the "intercalary vein." Next in order is the "ulnar vein" (*u*), which gives off several branches (*u'*, *u''*, etc.). The upper division of this vein (*o*) is known as the "posterior ulnar" or the "sub-median vein." Close to and parallel with it near the upper or hind margin of the wing cover is the undivided anal vein (*a*); while the uppermost vein of the wing cover, also undivided, is the "axillary vein" (*x*).

The tegmina is divided by these veins into three areas: The "costal" or "marginal area" (*M*) forms the lower or front edge of the wing cover and is bounded above and behind by the humeral vein.

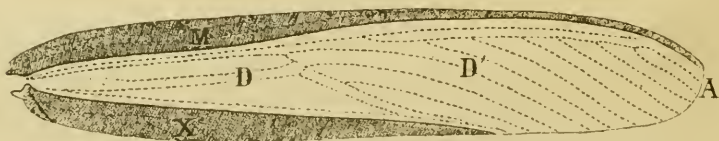


Fig. 11. Right tegmina of a locust, showing the "areas" designated in the text.
(After Saussure.)

The "median" or "discoidal area" (*D*) is much the largest and lies between the humeral and posterior ulnar veins. The "anal" or "dorsal area" (*X*) is the free margin lying along the back above and behind the anal vein. The posterior end of the wing cover (*A*) is known as the "apical margin."

The inner or second pair of wings are joined to the metathorax, and when at rest lie folded beneath the tegmina. If, in a fresh example, the dark colored marginal vein be pulled outward or forward with a pair of forceps, it will be seen that the wing is a thin, parchment-like membrane, with a stiff front edge, which is nearly straight, while the rounded outer and hind margins are thin and flexible. When in flight, the wing is fully extended, its upper surface being

convex, while its front margin is rendered still more rigid by being overlapped by the internal margin of the upper wing or tegmina. The numerous veins radiating from the base are so arranged that their elasticity causes the wing to fold upon itself like a fan as soon as its margin is released. The principal veins correspond in position to those of the tegmina, and have the same names. Both tegmina and wings are wanting in a number of species of Orthoptera, while in others the tegmina are present and the wings absent.

THE LEGS of a locust are six in number, arranged in pairs, one pair being joined to each of the divisions of the thorax. The first and second pairs are much smaller than the third, but the number and name of the joints is the same. They unite with the body at a different angle from the hind or third pair, and are therefore adapted to crawling and clinging to grass stems or other support, rather than to leaping.

The hind pair or leaping legs of the locust are composed of five parts:

The "*coxa*" (*c*), or basal division, which is joined to the thorax; a small segment, the "*trochanter*," (*tr*), immovably joined to the upper apical portion of the coxa; the "*femur*" (*f*), a long, swollen, club-shaped segment, which makes up nearly half the length of the limb. When the animal is at rest, it extends upward and backward, with its apical end above the dorsal surface of the body. This joint contains powerful leaping muscles. The "*tibia*" (*ti*), is about as long as the femur, but is very slender and of uniform diameter. When

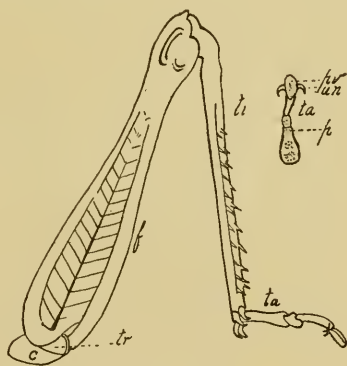


Fig. 12. Hind leg of a locust.

(After Lugger.)

at rest it extends downward and backward, at an acute angle from the apex or knee of the femur, but in the act of jumping it is thrown backward and the limb becomes straight. It bears on each of its lower outer margins a row of spines, and at the end, one or more pairs of longer spines or spurs known as "*calcaria*." The tibiae of the fore legs of many Orthoptera are much modified for use in burrowing or prehending food. The "*tarsus*" (*ta*) or foot of the locust is made up of three movable joints. The first and longest has upon its lower surface a soft pad (*p*) which, by its adhesion to foreign bodies, serves as a point of resistance in leaping. The second

joint is much shorter and carries a smaller pad. The third joint is long and slender, with two curved, pointed claws or "*ungues*" (*un*); between which is a concave sucking disk or pad, known as the "*pulvillus*" (*pr*). In some families of Orthoptera the tarsus is made up of four or five joints instead of three.

THE ABDOMEN.

The abdomen or hind portion of the body of the locust (See Figs. 2 and 4) is composed of ten more or less complete segments, so united as to be movable in a small degree. Each segment is composed of two parts, a "*tergum*" or upper portion, and a "*sternum*" or under piece. The tergum is crested or bent in the median line to form a ridge, the two sides, sloping downward, being known as "*tergites*." The sternum of the first or basal abdominal segment is united firmly to that of the metathorax. The tergites of this segment, in the locust, each contain a large opening closed by a membrane, the "*auditory organ*" or ear. However, the ears of

many Orthoptera are borne upon the basal portion of the front tibiae. Eight of the abdominal segments of the locust have a small opening on the lower margin of each "*tergite*." These are "*spiracles*" or external openings of tubes which serve as air passages. The ninth and tenth abdominal segments of the locust

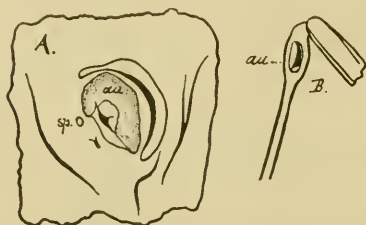


Fig. 13. Auditory organs or ears—(A), of a locust; (B), of a katydid. (After Lugger.)

are more or less modified in both sexes. The abdomen of the female ends in a double pair of short curved horny plates, known as the "*valves of the ovipositor*." In the other families of Orthoptera in which the ovipositor is visible, these plates vary greatly in form and size. The valves in the female locust are used in forcing the earth aside, thus forming a pit in which the eggs are deposited. Between and hidden by them is the ovipositor proper.

The ventral portion of the last abdominal segment of the male locust is a large, upcurved, spoon-shaped piece known as the "*subgenital plate*." Attached to the tergum of the next to the last segment are a pair of appendages known as the "*cerci*." In the male locust these are unjointed, and in the different species vary much in size and shape, affording valuable characters for classification. In many of the other families they are jointed, and more or less hairy.

The cerci of the female are much smaller than those of the male, and in other Orthoptera are often wanting. The tergum or upper portion of the tenth abdominal segment is a triangular, often thick solid plate, known as the "*supra-anal*" plate. At the base of this plate and resting upon it, a pair of small projections, known as "*furcula*" are usually present. In certain genera of locusts the shape, size and relative position of these afford valuable specific characters.

The above constitute the more important external parts of the locust, the characters of which are used in determining the name of a member of the order Orthoptera. As will be seen in the pages which follow, these different parts vary much in size and in form, but the names given to them apply as well to the members of one family as to another. By referring to the accompanying figures, and by observing carefully the parts of the specimen in hand, the beginner need have little hesitation in deciding as to whether the description agrees with that specimen.

INSECTS OF THE ORDER ORTHOPTERA.

All true insects can be separated into two great groups, based upon the kind of changes or transformations which they undergo before reaching the adult or winged stage. To one group—the *Metabola*—belong those insects which undergo what is termed a complete metamorphosis. In this group there are four distinct stages—the egg, larval, pupal and imago—in the order named. No insect is hatched from the egg with wings, and when an insect reaches the winged stage it is adult, and never grows thereafter. Thus the gnats and midges are not the sons and daughters of the larger flies, but are full grown insects of themselves, which are undergoing the fourth or last stage of their lives. The second, the larval or wormlike stage, is the one in which the insect of this group is commonly the most injurious, for then it eats voraciously, and then is the only period of its life when it grows in size. The pupal, or third stage, is usually a quiescent one, the insect eating nothing and not increasing in size, but undergoing great changes of form. Thus the homely and often repulsive grubs, maggots and caterpillars, which are the larval forms of the beetles, flies and butterflies, respectively, enter the third stage as wormlike crawling creatures, and emerge from it as beautiful winged forms, sometimes glistening and gleaming with all the colors of the rainbow. This change of life and form is undoubtedly of great advantage to the most of this group of insects, as it tends to prevent the extinction of the species; since, if at a given moment the parents were swept out of existence, the young, living in a different station, would continue to represent the species.

The second group, the *Heteromelabola*, comprises those insects in which the metamorphosis is incomplete; the young, when hatched from the egg being wholly wingless and of the same general form as the parent. As the insect grows it moults its skin a number of times and wings develop gradually, there being no sharp line defining the

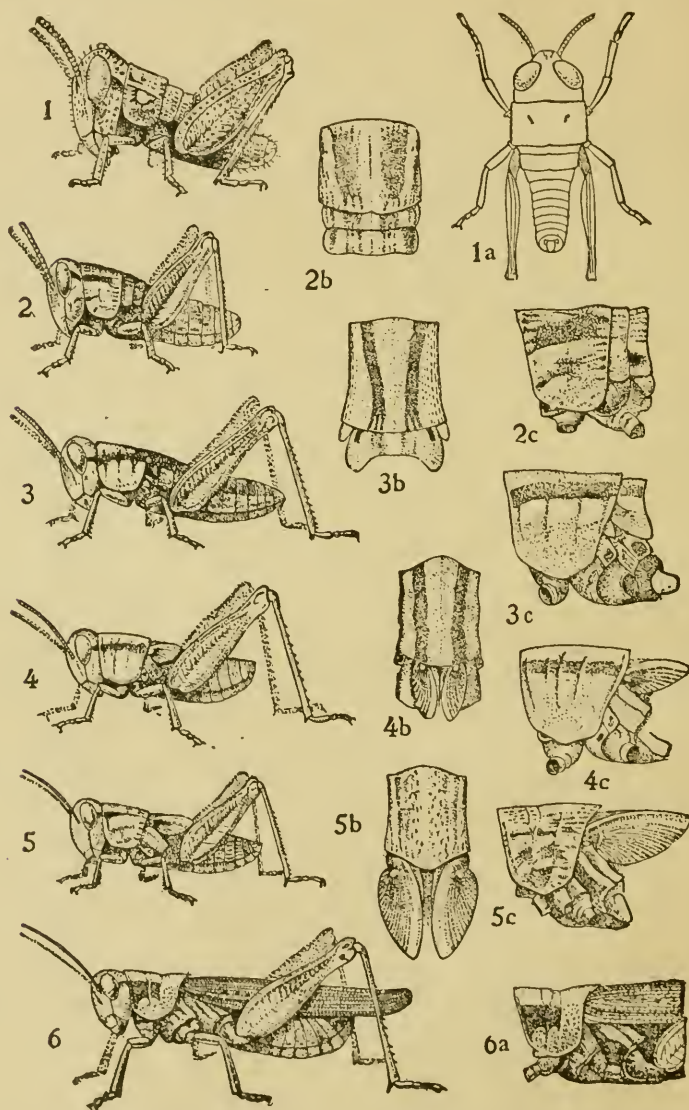


Fig. 14. Partial metamorphosis of *Melanoplus femur-rubrum*, showing the five nymph stages and the partial growth of the wings, which are first visible externally in 3, 3b, 3c.
(After Packard.)

larval and pupal stages. The young of all stages are called "nymphs;" they continue active and feed from the time of hatching until they reach the final moult and emerge therefrom mature or in the imago stage.

It is to this latter group, whose members undergo an incomplete metamorphosis, that the *Orthoptera*, the order of which this paper treats, belong. From other orders of the group, they may be known by their biting mouth parts and by the fact that the wings, when present, are four in number, the first pair being thick, leathery or parchment like, and usually overlapping when at rest. They form protective covers for the second pair, which are thinner, more delicate, and folded in plaits like a fan. The name *Orthoptera*, is derived from two Greek words, *orthos*, straight, and *pteron*, a wing; and refers to the longitudinal folding of the hind wings. The fore wings, or tegmina, are not used in flight, the hind pair alone being used for that purpose. The wings of some species of *Orthoptera* are wholly wanting, while a few others have only the front pair present.

About 900 species of *Orthoptera* are known from the United States. Of these 148 have been taken in Indiana; specimens of all but two being in the writer's collection. Of one of these, a large field cricket, *Gryllus firmus* Scudder, a single female from Franklin County served as one of the types and is now in the collection of Mr. Scudder at Cambridge, Massachusetts. Of the other, an earwig, *Forficula auricularia* L., four specimens taken at Lafayette are in the U. S. National Museum.

ENEMIES OF ORTHOPTERA.

*With the exception of the Mantids, all our *Orthoptera* are injurious, most of them being vegetable feeders. Were it not for the many natural enemies which prey upon them, they would abound each season in such vast numbers as to prove a veritable scourge. These enemies are many of them parasites which live only upon *Orthopterous* forms, and when the latter are abundant the parasites also increase in number, and soon devastate the hordes of insects. Besides these parasites, many predaceous or beneficial insects feed upon locusts and crickets; and birds, both wild and domesticated, are exceedingly fond of them. These parasites, predaceous insects and birds are, therefore, of great benefit to the farmer, and he should do all in his power to increase their number, in order to keep within bounds the different species of *Orthoptera*.

VEGETABLE PARASITES.—Among the most common parasites of locusts is a vegetable fungus, which in wet seasons attacks them, saps their veins and in time destroys many of their tissues. One often finds, after a long damp spell in late summer, many dead specimens of our larger locusts clinging to the tops of weeds. A close examination will show that their bodies are soft, and issuing from them in many places are the ends of fungous tubes. This locust fungus, *Empusa grilli* Fres, for some unexplained reason, impels the insects



Fig. 15. Locust—*Melanoplus bivittatus* Say—killed by a fungus.
(After Lugger.)

affected with it to climb some tall weed or grass stem and cling to it with such tenacity that the body remains long after death. The spores given off from the fungus of the diseased or dead locust, are more widely scattered by this peculiar habit which the host insect has of climbing tall weeds, as they can the more readily be dispersed over wide areas.

Besides this fungous parasite other vegetable bacteria attack locusts in favorable seasons. But this takes place only in long warm, damp spells; during which the locust has sought shelter and been deprived of food. Many are then often congregated together and one individual affected by the disease may inoculate hundreds. In dry seasons, the locusts and green grasshoppers are much more healthy and abundant and the damage which they do is much greater than in a wet season.

Upon the character of the winter of any year depends largely the number of Orthoptera and other insects which will be present the next summer. Most insects pass the winter in either the egg or the pupal stage; since these forms can readily withstand long and severe cold weather, in fact may be frozen solid for weeks and retain life and vigor, both of which are shown when warm weather and food appear again. Indeed, it is not an unusually cold winter, but one of successive thawings and freezings, which is most destructive to insect life. A mild winter encourages the growth of mold which attacks the hibernating larvæ and pupæ as soon as, from excess of rain or humidity, they become sickly; and it also permits the continued activity of insectivorous mammals and birds. Thus, moles, shrews, and field mice, instead of burying themselves deeply in the ground, run about freely during an open winter and destroy enormous numbers of pupæ; while such birds as the woodpeckers, titmice and chickadees are constantly on the alert, and searching in every crevice and cranny of fence and bark of tree for the hibernating eggs and larvæ.

ANIMAL PARASITES.—A number of parasites belonging to the animal kingdom use as their chief hosts the bodies of locusts and other members of the order Orthoptera. Chief among these animal parasites is the red locust mite, *Trombidium locustarum* Riley. On the first warm, sunny days of spring, as soon as the surface of the earth is fairly dry and warm, scores of minute "red spiders" can be seen

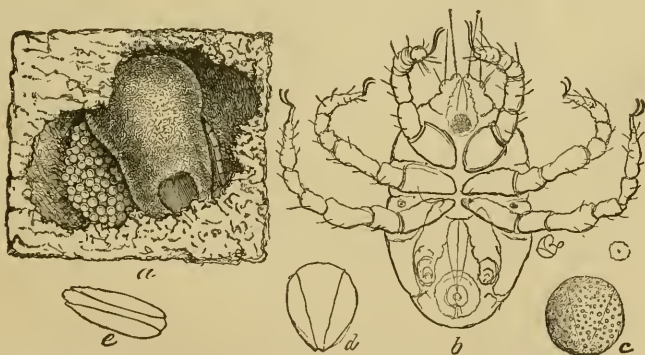


Fig. 16. *Trombidium locustarum*.—a, female with her batch of eggs (after Emerton); b, newly hatched larva, natural size indicated by the dot within the circle; c, egg; d, e, vacated egg shells. (After Riley.)

along any pathway in the woods and fields. They are especially common if locusts were abundant the year before. These red spiders are in fact mature red mites, the two sexes of which are shown in Fig. 17. Soon after appearing in spring, the sexes mate and the fe-

male soon deposits 300 or more small, globular eggs at a depth of a few inches in the soil. From each of these eggs there hatches, about the time the young locusts appear, a minute six-legged mite, which runs actively about in search of some host to which it may attach itself. When it happens upon a young locust, it fastens itself to the wings, wing pads or abdomen and uses its mouth parts to suck up the fluid portions of its host. In a short time its body increases in size, the legs grow smaller, and the mite resembles a small, globular mass of blood attached to the locust. Sometimes as many as twenty mites can be counted on a single host. When thus infested, the locust often becomes disabled, and drags itself about in a clumsy fashion, eats less and dies early, often before the mating and egg-laying season has arrived. In the swollen and almost legless condition which the mite soon attains, it can not move about, and so remains in one position until full grown, when it drops to the ground and enters the pupal stage from which it emerges as the "red spider-kin" of spring. It often becomes mature in late autumn and passes

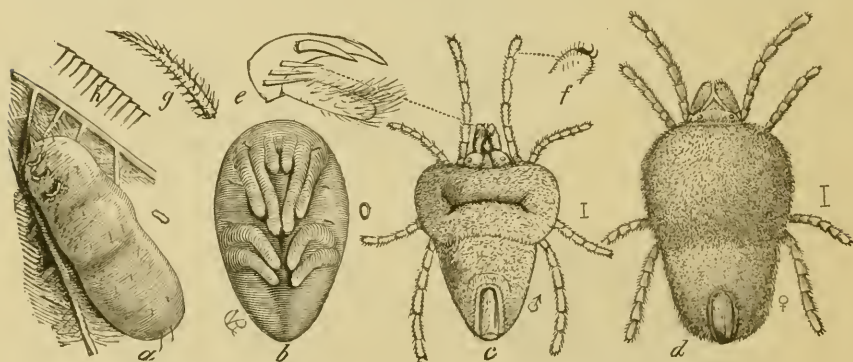


Fig. 17. *Trombidium locustarum*.—a, mature larva when about to leave the wing of a locust; b, pupa; c, male adult when just from the pupa; d, female—the natural sizes indicated to the right; e, pupal claw and thumb; f, pedal claws; g, one of the barbed hairs h, the striations on the larval skin. (After Riley.)

the winter in the ground where it is not idle, except when the temperature sinks below the freezing point. It feeds upon all sorts of soft food, and whenever it has access to the eggs of locusts it greedily eats them. In soil containing eggs of locusts large numbers of these mites congregate. They creep into every hole in search of these eggs and thrive upon such rich food. The great advantage of fall plowing over all other remedies against locusts is seen in regard to these red mites, as the plowing of fields in which the eggs of locusts have been deposited will destroy the young locusts hatching from them,

but not the mites, which can easily work their way toward the surface.

Other parasitic animals besides these mites often attack the different species of Orthoptera. On a number of occasions I have found protruding from the abdomens of green grasshoppers and crickets a slender "hair worm" or "horse-hair snake," a species of *Gordius*. If the body of such grasshopper or cricket be cut open the interior is often found to be almost filled with this parasite, which is many times longer than its host, and it will be seen that all the important organs of the latter are pressed to one side and unable to perform their necessary functions. Locusts so affected are seldom able to propagate their kind.

Among insect enemies of the Orthoptera, which aid largely in keeping down their numbers, are "Tachina Flies," "Flesh Flies," "Bee Flies" and "Blister Beetles." Tachina flies are mostly of a gray color, and resemble large house flies. In fields where locusts are abundant, one of these flies may often be seen hovering over a large specimen, awaiting a favorable opportunity to deposit one or more of its eggs on the neck or beneath the wing. These eggs hatch into larvæ or maggots which eat their way into the body of the locust. There they seem to avoid the most vital parts, but feed upon the fatty secretions stored up for future use of the reproductive organs. Locusts so affected have a soft, flabby body, and can often be readily caught by the hand. They never mate, and perish much sooner than the healthy, unaffected individuals.

The flesh flies attack locusts, katydids and grasshoppers in much the same manner as do the tachina flies, and their maggots are often found existing as true parasites upon the vitals of these orthopterous insects. When the maggots of either of these flies become full grown, they burrow through the body wall of the locust and drop to the ground, where they enter the earth and pass through the pupal stage from which they emerge as fully winged insects, ready for attack upon a new generation of locusts.

The egg clusters of locusts, crickets and other Orthoptera in the ground are often attacked by the larval forms of bee flies and blister beetles. The bee flies are of a blackish gray color, densely covered with pale yellow hairs, and in June and July may often be seen hovering above the ground, or feeding upon the honey of various species of wild flowers. Their eggs are laid among or close to the egg masses of the locust, and their larvæ feed upon and destroy myriads of the eggs of the locusts and crickets.

Three or four species of blister beetles or "old-fashioned potato beetles" exist in Indiana, and in the winged or full grown stage are often very injurious to potatoes and allied plants. The eggs of the blister beetle are laid in the ground in late summer, and the larvæ soon hatch and move actively about in search of animal food, in the form of egg masses of other insects. They have often been found feeding upon the eggs of locusts and other Orthoptera and are undoubtedly of much aid in keeping within bounds these injurious forms.

Many of the ground beetles or *Carabidae* feed, during both their larval and mature stages, upon locust eggs. About 350 species of this family of beetles occur in Indiana, and all are beneficial. In the mature stage they are long legged, rapid moving forms, which mostly hide by day beneath logs and rubbish and run actively about at night in search of some form of flesh upon which they may make a meal. Since insect life is the most common form which they find on or beneath the ground, it is but natural that most of their food is composed of it. The species of *Amara* and *Calosoma*, two of which are



Fig. 18. *Amara obesa* Say. Twice natural size. (After Riley.)

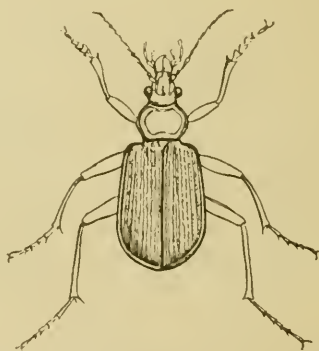


Fig. 19. *Calosoma scrutator* Fab. Natural size.

figured herewith, are among the most common and beneficial of this family of beetles. The larvæ of *Amara* may, in autumn, often be found feeding on the egg masses of the locust.

Higher in the scale of animal life are many forms which are among the best friends the farmer possesses, yet many of them he destroys on sight through ignorance of their beneficial habits. Chief among these are shrews, moles, salamanders and snakes. Both shrews and moles are burrowing mammals which feed almost wholly upon insect life. True, the latter sometimes destroy the seeds of corn and vegetables, but the good which they do in destroying the eggs and larvæ

of injurious insects far outweighs the bad. Salamanders, or ground puppies, live beneath logs and chunks and burrow into the surrounding region in search of eggs and larvæ, while snakes feed largely upon the young and mature of grasshoppers and locusts, yet all are destroyed at sight.

Many species of birds use as food both the young and full grown of all kinds of Orthoptera. The Division of Ornithology at Washington, and other authorities, have made investigations of the stomachs of many species of birds, and have found that the following species which occur in Indiana feed largely upon locusts, grasshoppers and other forms of Orthoptera.

LIST OF INDIANA BIRDS WHICH ARE KNOWN TO FEED
UPON ORTHOPTERA.

Franklin's Gull.	Killdeer.
Black Tern.	Quail.
American Bittern.	Ruffed Grouse.
Least Bittern.	Prairie Hen.
King Rail.	Wild Turkey.
Sora.	Mourning Dove.
Wilson's Snipe.	Marsh Hawk.
Golden Plover.	Baltimore Oriole.
Red-tailed Hawk.	Common Blackbird.
Red-shouldered Hawk.	Vesper Sparrow.
Broad-winged Hawk.	Chewink.
Black Hawk.	Dickcissel.
American Sparrow Hawk.	Scarlet Tanager.
Yellow-billed Cuckoo.	Butcher Bird.
Black-billed Cuckoo.	Red-eyed Vireo.
Red-headed Woodpecker.	Yellow-throated Vireo.
Night Hawk.	Water Wagtail.
Phoebe.	Yellow-breasted Chat.
Prairie Horned Lark.	Mockingbird.
Blue Jay.	Catbird.
Common Crow.	Brown Thrasher.
Bobolink.	Hermit Thrush.
Cowbird.	Robin.
Red-winged Blackbird.	Bluebird.
Meadow Lark.	

Of the foregoing list, those which feed mainly on Orthoptera during the summer season are the hawks, blackbirds, crows, blue jay, prairie chicken, mockingbird and bluebird. All of these birds are, however, beneficial in the highest degree and all should, at all times, be protected from their enemies, chief among which is the youth with his shotgun, or the small boy with egg-hunting proclivities.

About the best remedy for Orthoptera on a farm is a large flock of turkeys. Under the leadership of an experienced gobbler, almost their entire time during the summer and fall months is spent in wandering over the fields and pastures in search of the fat and juicy nymphs of locusts, grasshoppers and crickets. Indeed, most of the luscious white and brown meat of our Thanksgiving and Christmas dinners was once grass, then grasshopper, and finally turkey. No better and more practical remedy can be devised, for the damage which the insects do is, especially in these days of "turkey trusts," often more than compensated by the value of the pounds of flesh which this domesticated fowl stores up from its favorite food of locusts.

BIBLIOGRAPHY AND SYNONYMY.

In the preparation of this paper, the following papers and general works on Orthoptera have been consulted or are referred to in the synonymy which follows the scientific name of each species.* In order to save space the titles of the papers and works are not given in the synonymy, but each is known by a certain number, printed in open space figures, which, in the synonymy, immediately follows the name or abbreviation of the author, and all references to that paper bear the same number. For example, Scudder's "Materials for a Monograph of North American Orthoptera," in Vol. VII of the Journal of the Boston Society of Natural History, bears the number 141 in the Bibliography, and whenever Scudd. is followed by the open space number 141, reference is made to the paper mentioned. Thus, on page 242, under *Orphulella speciosa* (Scudder), we find in italics the name *Stenobothrus speciosus* Scudd., 141, VII, 1862, 458. This shows that on page 458 of the "Materials for the Monograph of North American Orthoptera" there is, under the name *Stenobothrus speciosus*, a description or important notice of the species now known as *Orphulella speciosa* (Scudder). In this particular instance the original description is referred to. When in the original description a species was placed by the author in a genus different from that to which it is now referred, the name of the author is placed in parenthesis. In the example referred to, the locust described as *speciosus* was placed in the genus *Stenobothrus* by Mr. Scudder. It is now recognized as belonging to the genus *Orphulella* as at present limited. Hence Scudder's name is placed in parenthesis.

* An asterisk (*) preceding the number in the Bibliography denotes that the paper referred to has not been seen by the author, the title being quoted from Scudder's "Index to North American Orthoptera." All papers not preceded by an asterisk are in the author's library.

Most of the species of Orthoptera found in Indiana have been mentioned in so many different works that it is impossible to make reference to them all. I have therefore cited in the synonymy only such works as include descriptions or figures of the species in question or important information regarding its habits and life history. I have thus excluded most of the local lists, but have included papers which contain previous references to its occurrence in Indiana. I have also, in all instances, given the page of Scudder's "Catalogue of North American Orthoptera" on which the species is mentioned, as this catalogue is, in the main, used as the basis for the arrangement of families and genera, and for the synonymy adopted. Special students who wish a more extended synonymy are referred to Scudder's "Index to North American Orthoptera," which includes every known reference to each species up to the close of the year 1900.

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A DESCRIPTIVE CATALOGUE OF THE ORTHOPTERA KNOWN TO OCCUR IN INDIANA.

The order *Orthoptera* may be subdivided into two classes or sub-orders, which in turn are subdivided into seven families. The sub-orders may be distinguished by the following table:

KEY TO SUB-ORDERS OF ORTHOPTERA.

- a. Legs of equal or nearly equal size, the hind femora not being enlarged for leaping. Organs for producing sound absent. Tegmina and wings of nymphs, when present, in a normal position. Ovipositor concealed by the sub-genital plate. .NON-SALTATORIA, p. 167
- aa. Legs of unequal size, the hind femora fitted for leaping, being much thickened and swollen, and usually much longer than the middle femora. Organs for producing sound usually present. Tegmina and wings of nymphs, when present, in a reversed position. Ovipositor usually exerted so as to be plainly visible. SALTATORIA, p. 210

NON-SALTATORIA.

To this class or sub-order belong four of the seven recognized families of Orthoptera. These may be distinguished one from another by the following table:

KEY TO FAMILIES OF NON-SALTATORIAL ORTHOPTERA.

- a. Body short, narrow, more or less flattened. Head horizontal, the mouth in front. Tegmina leathery, very short, without veins; meeting in a straight line down the back. Tarsi three-jointed, without pulvilli or pads. Abdomen of both sexes terminating in horny forceps-like appendages.FORFICULIDÆ, p. 168
- aa. Body either short and wide, or elongate and narrow. The mouth at either lower or back portion of head (depending upon the position of the latter when at rest). Tegmina usually parchment like, thickly veined. Tarsi five-jointed. Abdomen terminating in cerci, but these never distinctly forceps-like.
 - b. Body short, broad, oval, depressed. Head almost wholly concealed beneath the pronotum; the mouth posterior (at back portion when at rest). Ocelli generally two. Pronotum shield shaped, transverse. Legs compressed. Insects of rapid motion.BLATTIDÆ, p. 172
 - bb. Body elongate, narrow. Head, free, not covered by pronotum; the latter longer than broad. Ocelli three or wanting. Legs slender, not compressed. Insects of slow motion.
 - c. Head oblique; mouth inferior. Ocelli three. Antennæ short. Pronotum generally longer than any other segment. Front pair of legs, raptorial, fitted for grasping. Cerci jointed.MANTIDÆ, p. 198

cc. Head sub-horizontal; mouth sub-inferior. Ocelli often wanting. Antennae generally longer than the body. Pronotum but little longer than head. Front pair of legs simple. Cerci without joints. . . . PHASMIDÆ, p. 203

Family FORFICULIDÆ.

This family of the order *Orthoptera* comprises those short, narrow, flattened insects, with legs of equal size, commonly known as "earwigs." They are so different from the larger and better known *Orthoptera* that many writers have placed them in a distinct order, the *Dermaptera* or *Euplexoptera*.

The *Forficulidæ* have the head flattened and horizontal with the mouth in front. The thorax is short and narrower than the head. The tegmina or wing covers are leathery or horny in texture, meet in a straight line down the back; are without veins and cover only a portion of the abdomen. The inner wings, when present, are very large, and bear numerous radiating veins which act as the bars of a fan in folding and unfolding the wings. When at rest, these wings are folded both lengthwise and crosswise beneath the protecting tegmina. The abdomen ends in a pair of appendages which somewhat resemble forceps. Were it not for these, the earwigs would resemble very closely the *Staphylinidæ* or rove beetles of the order *Coleoptera*. Those species which possess inner wings use these forceps to aid in folding and unfolding those organs, and they are also used as clasping organs during the mating of the sexes. As the earwigs never leap, their hind femora are not enlarged. The tarsi are never more than three-jointed and have no pads between the claws. No organs for producing sound are present, and, as far as known, hearing organs are also absent.

The name "earwig" was given to these insects in Europe, where they are abundant and better known than in this country. It is a common belief among peasants and the uneducated masses, that these insects will, when opportunity offers, enter the ears of human beings and injure the sense of hearing. Such belief is, of course, wrong and nonsensical, the insects being wholly harmless. Like the members of the next family, the *Blattidæ* or cockroaches, they live in cracks and crannies in walls and floors, beneath rubbish and the bark of logs and stumps. From these retreats they come forth only by night to feed upon dead insects and upon small snails and other sluggish moving forms. Like other nocturnal insects they are attracted by light, and on the ground beneath the electric lights of cities in Florida and Old Mexico, I have found them in numbers. The female is said to

brood over the eggs, but to abandon the young as soon as hatched. In this she resembles some of our common myriapods of the genus *Lithobius*, which are often found beneath logs and rubbish curled up around their eggs, but which are never seen in company with the young.

Earwigs are common in the cities along the seacoast, especially those of the Southern States and tropical and semi-tropical countries. Inland, especially in temperate and cold regions, they are scarce. The family is not, as yet, divided into sub-families. Six genera and fourteen species are listed by Scudder from the United States. Of these, three species, representing two genera, have been taken in Indiana. They belong to that division of the family in which the sixth joint of antennæ is as long as, or very nearly as long as, the first. The following key will serve to separate the two genera:

KEY TO GENERA OF INDIANA FORFICULIDÆ.

- a. Sixth joint of antennæ cylindrical, many times longer than broad; second tarsal joint produced beneath the third.....
I. FORFICULA, p. 169
- aa. Sixth joint of antennæ plainly obconic, about three times as long as broad. Second tarsal joint minute, simple, compressed.....
II. LABIA, p. 171

I. FORFICULA Linnæus (1758).

Size, medium; whole body more or less flattened, rather long and slender. Antennæ a little more than half as long as the body, 10 to 14-jointed, the joints cylindrical, more than four times as long as broad. Abdomen not expanded in the middle; all the dorsal segments before the last, of nearly equal length in both sexes. First tarsal joint a little longer than the third; the second short, dilated at the apex and lobed, passing beneath the third joint.

This genus is the richest in species of any of the family, and is more widely spread than any, being found wherever earwigs occur. Six species belonging to it are known from the United States, two of which have been taken in Indiana. These may be separated by the following:

KEY TO INDIANA SPECIES OF FORFICULA.

- a. Wings wanting; antennæ 12-jointed.....1 *aculeata*, p. 170
- aa. Wings protruding beyond the tips of tegmina; antennæ 14-15-jointed.
2 *auricularia*, p. 170

1. *FORFICULA ACULEATA* Scudder.

Forficula aculeata Scudd., 156, II, 1876, 254, 256; Id., 157, I, 1876, 177; Id., 158, XVIII, 1876, 262, 310; Id., 164, 1879, 41; Id., 188, 1900, 5; Beut., 3, VI, 1894, 256.

Antennæ 12-jointed. Pronotum longer than broad, narrower than the head. Tegmina nearly twice as long as the pronotum, truncate. Inner wings wanting. Forceps of male, three-fourths as long as the abdomen, slender, arcuate, bent downward a little at apex of basal third; becoming again horizontal a little before the tip; a slight pointed tooth present at second bend. Forceps of female shorter than those of male, nearly straight, the inner edges touching for most of their length, the tip incurved.



Fig. 20. *Forficula aculeata* Scudder. Male, two and one-half times natural size. (Original.)

Color, dark chestnut brown. Palpi, legs, edges of pronotum and outer two-thirds of tegmina, yellow.

Measurements: Length of body, male, 10 mm., female, 11 mm.; of antennæ, male, 7.5 mm., female, 7 mm.; of tegmina, male and female, 3 mm.; of forceps, male, 5 mm., female, 3.5 mm.

This earwig was taken a mile southwest of Mt. Vernon, Posey County, on April 9, 1901. It was found to be fairly common beneath rubbish and leaves in some woods along the bank of the Ohio River. It has not been noted elsewhere in the State, though it is liable to be found anywhere within its bounds as its range includes the northern United States east of the Mississippi River. The type specimens came from northern Illinois and southern Michigan.

2. *FORFICULA AURICULARIA* Linnaeus.

Forficula auricularia L., 81, Ed. X, I, 1758, 423; Scudd., 155, II, 1876, 254; Id., 157, I, 1876, 177; Id., 158, XVIII, 1876, 311; Id., 188, 1900, 5; Beut., 3, VI, 1894, 256; Brun., 35, 1899, 133; Rehn., 112^a, XIV, 1903, 125.

"Fusco-ferruginous; antennæ 14-15-jointed; basal joint, sides of pronotum, and legs testaceous; tegmina and wings dull luteous, the former half as long again as the pronotum; forceps of male usually as long as the abdomen; horizontal, depressed, and dilated at the base, and beyond rather strongly arcuate, tapering to a point, the extreme base of inner edge tuberculato-denticulate, with a distinct inner tooth

at base of arcuate portion. Body (average), 11 mm.; forceps, male, 4-8 mm.; female, 3 mm."—*Scudder*.

I have not seen this earwig in Indiana, but Rehn, *loc. cit.*, states that four males, collected by F. M. Webster, at Lafayette, Indiana, about May 15, 1889, are in the collection of the U. S. National Museum. It is an introduced species, which has before been recorded in the United States from New York and New Jersey.

II. LABIA Leach (1815.)

Size, small. Body, flattened and slender, the abdomen slightly widened in the middle. Antennæ about half as long as the body, 10 to 13-jointed, the joints moniliform, or of equal size throughout, obconic, about three times as long as broad. Both tegmina and wings present in our species. First and third tarsal joints equal, the second minute, simple, compressed. Forceps seldom more than half as long as the abdomen; in the male, simple, arcuate, horizontal; in the female, simple, straight, incurved at the tip, unarmed.

This genus differs from the preceding principally in the simple character of its middle tarsal joint, and in the shorter obconic joints of the antennæ. Four species are accredited to the United States, one of which occurs in Indiana.

3. LABIA MINOR (Linnaeus.) The Little Earwig.

Forficula minor L., 81, Ed. X, I, 1758, 423; Burm., 40, II, 1838, 754; Fisch., 55, 1853, 52, 70, Plate VI, Fig. 7.

Labia minor Glov., 62, 1872, Plate X, Fig. 3; Scudd., 155, II, 1876, 257; Id., 157, I, 1876, 178; Id., 158, XVIII, 1876, 320; Id., 188, 1900, 6; Comst., 41, 1888, 91; Fern., 53, 1888, 53; Bent., 3, VI, 1894, 257; Lugg., 84, 1898, 86, Figs. 49, 50.

Labia minuta Scudd., 141, VII, 1862, 415; Pack., 104, 1869, 507; Glov., 62, 1872, Plate I, Fig. 10.

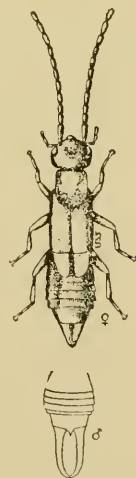


Fig. 21. *Labia minor* (L.) Female. Four times natural size. Abdomen of male showing form of forceps. (After Lugg.)

Antennæ 10-12-jointed. Pronotum narrower than the head, scarcely longer than broad. Tegmina nearly twice as long as the pronotum, the wings, when at rest, extending fully half their length beyond the tip of tegmina. Forceps of male about three-fourths the length of abdomen, rather heavy, minutely toothed on

the inner edge. Last ventral segment of male with a slender, apical, compressed, upcurved tubercle. The entire body is covered with fine, soft, yellowish hairs.

Color: Head and sides of abdomen nearly black; mouth parts, antennæ, thorax, tegmina, exposed parts of wings and middle of upper side of abdomen, yellowish brown; last segment of abdomen and forceps, reddish brown; legs and last two joints of the antennæ, honey yellow.

Measurements: Male, length of body, 5 mm.; of antennæ, 3.2 mm.; of tegmina, 2 mm.; of forceps, 2 mm.

Although the range of this little earwig is said to cover Europe and the United States, and Canada east of the Rocky Mountains, I failed to detect it in Indiana until May 12, 1903, when I took a single male from beneath the bark about the base of a sweet gum tree near Grand Chain, Posey County. It doubtless occurs throughout the State, but is overlooked on account of its small size. A close search about electric lights in the cities and towns of the State will doubtless reveal its presence in numbers.

Family BLATTIDÆ.

The members of the family *Blattidæ*, commonly known as cockroaches, may be known from the other families of Orthoptera by their depressed, oval form; by their nearly horizontal head which is bent under and almost concealed by the broad pronotum, so that when at rest the mouth projects back between the bases of the first pair of legs; by their slender depressed legs of equal length and size; and by the absence of either ovipositor or forcipate appendages at the end of the abdomen. The ocelli are usually but two in number and the tarsi are 5-jointed.

The pronotum is generally transverse or shield-shaped, with rounded angles. The rings of the abdomen overlap each other and are capable of great extension and depression, so that these insects seem to be pre-eminently fitted for living in the narrow crevices and cracks which they inhabit. The legs are of peculiar structure in that they are long and more or less flattened, thus enabling the cockroaches to run with surprising swiftness, so that the family has been placed by some writers in a separate sub-order, the *Cursoria*, or runners. The wing covers, or tegmina, are leathery, translucent, and when well developed, overlap when at rest; while the wings never exceed the tegmina in length, and in some cases are rudimentary or even wanting.

From the other Orthoptera (except the *Mantidæ*) the *Blattidæ* differ widely in the manner of oviposition, as the eggs are not laid one at a time, but all at once in a peculiar capsule or egg case called an oötheca. These capsules vary in the different species as regards the size, shape, and the number of eggs they contain, but they are all similar in structure. Each one is divided lengthwise by a membranous partition into two cells. Within each of these cells is a single row of cylindrical pouches, somewhat similar in appearance to those of a cartridge belt, and within each pouch is an egg.



Fig. 22. Oötheca of *Blattella orientalis*; a, side; b, end view. Natural size indicated by outline figure. From "Household Insects", published by U. S. Div. of Entomology.

The female cockroach often runs about for several days with an oötheca protruding from the abdomen, but finally drops it in a suitable place and from it the young, in time, emerge. While this method of oviposition is the one practiced by all the species of common occurrence in the United States, there seem to be exceptions to it, as Dr. C. V. Riley has recorded the fact of an introduced tropical species, *Panchlora poeyi* Sauss., being viviparous, the young emerging alive from the body of the parent, and a careful dissection of the latter showing no trace of either eggs or oötheca.

All young cockroaches resemble the parents in form but are wholly wingless, the wings not appearing until after the fifth or last moult. The young are often mistaken for the mature by persons who have not made a careful study of the life history of the insects; and those of one or two well-known and common forms have, in the past, even been described or figured as distinct wingless species by some of the leading entomologists of the country.

To the paleontologist, interested in tracing back the ancestry of insects, the *Blattidæ* become at once a group of surpassing interest, for some of the oldest known insects are cockroaches from the Silurian and Carboniferous rocks. Between 130 and 140 fossil species of the family are known from the Paleozoic rocks of the United States, principally from the Carboniferous formations, but some from all the ages as far back as the middle Silurian. Mr. S. H. Scudder, of Cambridge, Mass., the most eminent authority on insect paleontology, says of the cockroach: "Of no other type of insect can it be

said that it occurs at every horizon where insects have been found in any numbers; in no group whatever can the changes wrought by time be so carefully and completely studied as here; none other has furnished more important evidence concerning the phylogeny of insects."

The Blattidæ are pre-eminently tropical insects, and though abundantly represented in individuals, the number of species inhabiting the United States is comparatively few, but 34 being listed in Seudder's Catalogue. These are divided among seven sub-families and eighteen genera. Aside from two or three sub-tropical species which are often introduced in bananas and other fruit, but which soon die, and are not, therefore, considered in the present paper, nine species have been taken in Indiana. These represent but two of the sub-

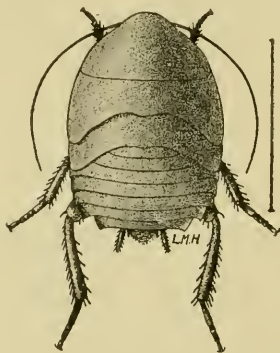


Fig. 23. Nymph of *Nymphora holosericea* Klug. One of the more common tropical roaches introduced on fruit.* (After Lugger.)

families and five of the genera, belonging to that division of the family in which all the femora, or at least the middle and hind pair are spined on the under side. These sub-families may be separated by the following table:

A SYNOPSIS OF THE SUB-FAMILIES OF BLATTIDÆ KNOWN TO OCCUR IN INDIANA.

- a. Last ventral segment of the female abdomen plane, not compressed and not divided; fore femora rarely armed beneath on the inner margin with many distinct spines; if so armed, then the sub-genital styles are unequal, or one is wanting. . . . BLATTINÆ, p. 175

*Nymphs of this sub-tropical roach have been taken in Indianapolis and Terre Haute. A mature male was sent me from Mt. Carmel, Illinois, by Dr. J. Schneck. It was an inch and a fourth in length, a uniform dark brown in color, with numerous small hairs on the pronotum and tegmina.

- aa. Last ventral segment of the female abdomen compressed so as to form a carina or ridge on its under side, and divided so as to be bi-valved; fore femora armed beneath with many spines on the inner margin.....PERIPLANETINÆ, p. 191

Sub-family BLATTINÆ.

In this sub-family the body of the male is elongate; that of the female usually distinctly broader. The head is strongly depressed and almost wholly covered by the pronotum. The antennæ in our species are setaceous. The posterior border of the pronotum is truncate or rounded. Both pronotum and tegmina are free from hairs. The tegmina are coriaceous or membranaceous, rarely corneous, in texture. The median vein of the wings sends but few branches to the apex; while the radial vein emits many parallel, simple veinlets to the costal margin. The tarsi are without pulvilli or pads. The last ventral segment of the female is relatively plane, not compressed or divided. The supra-anal plate of both sexes is but little produced, triangular, entire. The sub-genital plate of the male (except in the genus *Blattella*) bears a pair of minute styles.

To this sub-family belong all the native species of roaches found in Indiana, and one common introduced species, *Blattella germanica* L. The native species, as far as synonymy goes, are a badly mixed lot—so badly mixed, in fact, that more time has been spent upon them than upon any other group treated in this paper, and in the end the results are more unsatisfactory and less certain than in any other. This is due to the fact that the sexes differ so widely in appearance that they have been described as different species, and often placed in wholly different genera. Most of the descriptions have been made by foreign entomologists, who never saw a specimen in the field, and for that reason knew nothing of the relationship of the different individuals before them. However, the two sexes are so seldom found mating, that even the field naturalist can not be certain as to their relationship. I have collected Indiana *Blattidæ* for 15 years, and, as yet, am only positive as to the sexes of one of our native species—*Temnopteryx deropeltiformis* Brunn. The conclusions at which I have arrived regarding the others are based mainly upon finding both-sexes at the same time beneath the same hiding places on a number of occasions. This, however, is not positive proof that the sexes belong where I have placed them.

Saussure, followed by Scudder, has stated that the tegmina in both sexes of the genus *Temnopteryx* are abbreviated, yet this is not true of *T. deropeltiformis* Brunn., the only one of the United States spe-

cies in which both sexes are known. Prof. Lawrence Bruner, an acknowledged authority on North American Orthoptera, writes me that, as far as he knows, "all the females of *Temnopteryx* are short-winged, and all the males long-winged like the majority of the species of *Ischnoptera*." Prof. A. P. Morse kindly examined Mr. Scudder's collection for me, and states that, as far as he was able to ascertain, it contains no short-winged males of *Temnopteryx*.

Saussure and Scudder, in their "Keys to Genera of Blattinæ," also state that in the genus *Ischnoptera* the "tegmina are completely developed or in the female rarely abbreviate." In all my collecting, I have never seen a long-winged female of *Ischnoptera*. Bruner has written me that he does not possess a long-winged female or a short-winged male of the genus, and Morse also states that Scudder's collection contains no long-winged females of *Ischnoptera*. From these facts, and from others* gathered in the field and mentioned under the different species, I have concluded that the species of *Phyllodromia* and *Temnopteryx* listed by Scudder in his Catalogue* are but the females of certain species of *Ischnoptera* and have so placed them in the present paper. As a result, representatives of but three genera of the sub-family *Blattinæ* occur in the State. These may be separated by the following

KEY TO GENERA OF INDIANA BLATTINÆ.

- a. Sub-genital stylets present in the males. Tegmina of females abbreviate, reaching but little, if any, beyond the middle of the broad abdomen.† (Native species.)
 - b. Tegmina corneous; those of female obliquely truncate at apex. Ulnar vein of wings of male without branches to the vena dividers.....III. TEMNOPTERYX, p. 176
 - bb. Tegmina membranaceous or somewhat coriaceous; those of female usually broadly rounded at apex; sometimes angulate, but not truncate. Ulnar vein of wings of male emitting complete branches to the apical margin and incomplete branches to the vena dividers.....IV. ISCHNOPTERA, p. 178
- aa. Sub-genital stylets absent in the males. Tegmina of both sexes fully developed. Size small, body narrow. (Introduced species.)

V. BLATTELLA, p. 187

III. TEMNOPTERYX Brunner (1865).

Body oblong, that of male rather slender; that of female stouter, with the abdomen broader than the thorax. Head large and flattened; the vertex swollen. Antennæ longer than the body, rather stout. Ocelli wanting. Pronotum and tegmina somewhat corneous

* He does not list *T. deropeltiformis* Brunn.

†In the females of *I. pennsylvanica* they sometimes cover three-fourths of abdomen, but never reach its tip.

in texture, quite flat, the former nearly semi-orbicular in shape, much the broader in the female, the hind border a little rounded in the male, truncate in the female. Tegmina fully developed and much surpassing the abdomen in the male (of our species); abbreviate and with the apex obliquely truncate in the female. Abdomen very flat above, convex beneath. Supra-anal plate of the male, transverse, rounded; that of the female triangular. Sub-genital plate of the male, narrow, bearing two stylets; the one on the left usually the larger. Cerci rather long and stout, 10-jointed. Last ventral segment of the female abdomen broadly rounded, entire.

As noted above, I consider that certain species heretofore ascribed to this genus are females of species of *Ischnoptera*. This eliminates the nominal species *T. major* Sauss.-Zehnt. and *T. virginica* Brunn. of Scudder's Catalogue, representatives of which occur in Indiana, and leaves *T. deropeltiformis* Brunn. as our sole representative of the genus.

4. TEMNOPTERYX DEROPELTIFORMIS Brunner.

Temnopteryx deropeltiformis Brunn., 37, 1865, 87; Bl., 8, 1893, 160.

Main characters as given above. Disk of male pronotum with three impressions, one shallow, median and longitudinal, the other two deeper, semicircular and lateral. Tegmina of female covering about one-third of the abdomen, their inner edges meeting; those of male much surpassing the abdomen.

Color, a uniform dark mahogany brown, except the tibiae and tarsi of all the legs, which are a light reddish brown, the contrast between the two colors, in living specimens, being very striking. Wings of male transparent, slightly infuscated, the veins and anterior border light brown.

Measurements: Length of body, male, 14 mm., female, 15 mm.; of pronotum, male, 3.5 mm., female, 4.5 mm.; of tegmina, male, 15.5 mm., female, 5 mm.; width of pronotum, male, 4.5 mm., female, 6 mm.

In Indiana this handsome roach has, as yet, been noted only in Vigo and Crawford counties. In the former it was found in but one locality, the border of a marsh in a low sandy woods three miles east of Terre Haute. A single pair were taken on May 28, 1893, and on June 18, probably a dozen specimens were secured. They were hiding beneath small logs and sticks, and the males, when deprived of their shelter, flew actively away, while the

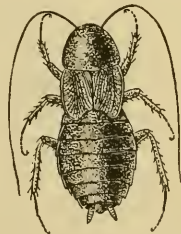


Fig. 24. *Temnopteryx deropeltiformis* Brunner. Female one and one-third times natural size. (Original.)

females could but crawl, and that rather sluggishly for a Blattid, toward a new hiding place. A mature male was taken in the same place on May 12, 1894. In June, 1902, a number were found in Crawford County beneath flat stones and rubbish on the tops of high hills near Wyandotte Cave. A single female was also captured while feeding upon a species of fleshy fungus (*Agaricus*) in dense woods in Marshall County, Illinois, about eight miles west of Terre Haute. Brunner (*loc. cit.*) recorded it from "Amerique du Nord," and I can find no other note of its occurrence in the United States.

IV. ISCHNOPTERA Burmeister (1838).

Body of male rather narrow, oblong; that of female broader, orbicular. Antennæ nearly or fully double the length of the body. Pronotum small, orbicular or of the form of an ellipse; in the male often much narrowed in front. Tegmina membranaceous, more or less translucent, longer than the abdomen in the males, abbreviated (in our species) in the females. Wings hyaline; "the discoidal (ulnar) vein, instead of sending longitudinal branches exclusively to the apical margin, sends also small oblique branches to the anal vein (vena dividens)." Cerci long and relatively stout, 12-jointed. Supra-anal plate of the male broad, the apex either truncate or rounded; that of female narrower, triangular and obtuse. Sub-genital plate of male bearing two rather long stylets which are often deflexed. Last abdominal plate of female entire.

Five species of our native roaches belong to this genus. They may be separated as follows:

KEY TO INDIANA SPECIES OF ISCHNOPTERA.

- a. Size large; length of body of male, 19 or more mm.; of body, including tegmina, 25 or more mm.
 - b. General color fuscous or chestnut brown; the center of disk of pronotum dark, the sides yellow.
 - c. Pronotum elliptical, nearly as wide in front as behind, the sides flaring, but little deflexed; the center of disk rufous.....5 *pennsylvanica*, p. 179
 - cc. Pronotum notably narrower in front than behind, the sides strongly deflexed; the center of disk black.....6 *inaequalis*, p. 182
 - bb. General color light reddish or yellowish brown; the sides of pronotum not markedly different in color from the center of disk.....7 *major*, p. 183

aa. Size medium; length of body of male, less than 15 mm.; of body, including tegmina, less than 20 mm.

d. General color of male, light reddish or yellowish brown; of female, reddish brown, the abdomen darker; inner edges of tegmina of female meeting or slightly overlapping.....8 *uhlcriana*, p. 184

dd. General color of male, dark reddish brown or chestnut; of female, piceous; inner edges of tegmina of female widely separated.....9 *intricata*, p. 186

5. ISCHNOPTERA PENNSYLVANICA (De Geer). The Pennsylvania Cockroach.

Blatta pennsylvanica De G., 57, III, 1773, 537, Plate 44, Fig. 4; Thom., 202, V. 1865, 440. (Male).

Platamodes pennsylvanica Scudd., 141, VII, 1862, 417; Glov., 62, 1872, Plate I, Figs. 1, 3; Riley 122, II, 1884, 172; Comst., 41, 1888, 93.

Ischnoptera pennsylvanica Brunn., 37, 1865, 135; Sauss., 132, VI, 1870, 63, Plate II, Fig. 35; Bl., 8, 1893, 158; Id., 16, 1899, 202, Fig. 43; Beut., 3, VI, 1894, 259; Lugg., 84, 1898, 96, Fig. 58; Scudd., 188, 1900, 7.

Blatta borealis Sauss., 128, 1862, 4, (Female).

Phyllodromia borealis Brunn., 37, 1865, 101; Scudd., 188, 1900, 8; Id., 189, IX, 1900, 100.

Ectobia flavocincta Scudd., 141, VII, 1862, 419; Brunn., 37, 1865, 57; Comst., 41, I, 1888, 93; Bl., 8, 1893, 161. (Female).

Blatta flavocincta Fern., 53, 1888, 51.

Ectobia lithophila Scudd., 141, VII, 1862, 418 (Immature).

Male: Size, large. Pronotum elliptic, the front border slightly the narrower, its margin straight; the hind border rounded; an ob-

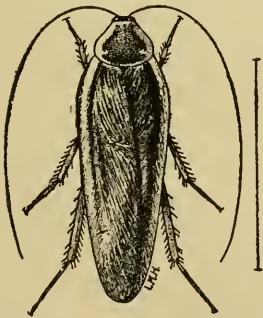


Fig. 25. *Ischnoptera pennsylvanica* (De Geer). Male. (After Lugg).



Fig. 26. *Ischnoptera pennsylvanica* (De Geer).=*Phyllodromia borealis* Sauss.=*Ectobia flavocincta* Scudd. (Female. Original.)

lique depression on each side, near the base. Tegmina membranaceous, more or less transparent, long and rather narrow, extending

much beyond the tip of abdomen. Wings as long as tegmina. Subgenital styles deflexed.

Female: Size medium, the abdomen broader than thorax, its greatest breadth contained less than twice in its total length. Pronotum much wider and of firmer texture than in the male; the disk a little convex and with no impressions; the hind margin nearly truncate; the front margin narrower, rounded; the lateral margins somewhat flaring, their posterior third slightly upturned. Tegmina broad, overlapping, covering from a half to three-fourths of abdomen, their apices rounded; the veins prominent. Inner wings narrow, about half the length of tegmina.

General color, chestnut brown to fuscous, the females the darker. Antennæ dusky; face reddish brown in center, the margins yellow. Disk of pronotum chestnut brown, margined on sides, and sometimes nearly in front, with whitish yellow. Tegmina of male smoky brown, lighter in freshly moulted specimens; those of female dark reddish brown; the outer basal two-thirds (male) or one-half (female) rather broadly margined with yellowish. Upper surface of female abdomen very dark brown. Legs of both sexes pale yellowish brown.

Measurements: Length of body, male, 21 mm., female, 16 mm.; of antennæ, male, 28 mm., female, 18 mm.; of pronotum, male and female, 5 mm.; of tegmina, male, 22 mm., female, 6-10 mm.; width of pronotum, male, 5.5 mm., female, 7 mm.

While I have never taken the sexes *in coitu*, there is no doubt in my mind but that the female of *pennsylvanica* is the roach heretofore known as *Blatta* or (*Phyllodromia*) *borealis* Sauss., and *Ectobia flavocincta* Scudd. That these last two names are synonymous has been shown by Scudder.*

As far back as May 27, 1894, I made the following entry in my field note book: "*Platamodes pennsylvanica* and *Ectobia flavocincta*, both mature and very common beneath the bark of red oak stumps and dead trees. Are the latter the females and the former the males of the same species? I often think so, but as yet have no positive proof." I have since on many occasions taken the two forms together, but have never seen a female of *pennsylvanica* nor a male of *flavocincta*, unless the latter be the female of the former. I can find no mention or description of the female of *pennsylvanica* in any work at my command. All illustrations of the species which have been published are of the male.

On the other hand, all mention and descriptions of *P. borealis* which note the sexes, with a single exception, relate to the female.

*Psyche, IX, 1900, 100.

The exception noted is that of Saussure who, in his original description of *borealis*, mentions the male, stating that the elytra are short, the supra-anal plate triangular, acuminate and sub-carinate. This is true of all the specimens of *borealis* in my collection. Several of them have oötheca partly protruding from the abdomen and the genital organs of all are similar. Prof. Morse has compared specimens of what I have called *flavocincta* with Scudder's types, and pronounces them the same.

I. pennsylvanica is the most common of our native roaches, having been taken in the State wherever collections have been made, beneath the loose bark of logs and old stumps. It is usually seen in the wingless stages, the mature individuals being common only from May 5th to October. The half grown young, described by Scudder as *Ectobia lithophila*, are of a shining, dark brown color, the dorsal surface of thoracic segments often lighter. As the long-winged males are attracted by light, country houses are often badly infested with them; and where food is scarce, the wall paper is sometimes much injured for the sake of the paste beneath. What the hordes of young which dwell under the bark of logs live upon is a question as yet unsettled, but the larvæ of other insects undoubtedly form a portion of their food, as in two instances I have found them feeding upon the dead grubs of a *Tenebrio* beetle; while living as well as decaying vegetable matter probably forms the other portion. The mating of the imagoes probably occurs in late spring and early summer, the newly hatched young being most abundant from mid-August until December. Females with oötheca protruding have been taken as early as May 19th and as late as September 3d. The young in various stages of growth survive the winter in the places mentioned, they being the most common insects noted in the woods at that season. Cold has seemingly but little effect upon them, as they scramble away almost as hurriedly when their protective shelter of bark is removed on a day in mid-January with the mercury at zero, as they do in June when it registers 100° in the shade.

The empty oötheca of this species are very common objects beneath the loose bark of logs and especially beneath the long flakes of the shellbark hickory. They are chestnut brown in color, from 5 to 9 mm. in length by 4 mm. in breadth, and are much less flattened than those of *Blattella germanica* described below. The dorsal or entire edge is slightly curved, or bent inward, after the fashion of a small bean, while the other edge is minutely serrate. The young, after hatching, evidently escape in the same manner as do those of the Oriental cockroach, as no break is visible in the empty capsule. The

general range of *pennsylvanica* is given by Scudder as "Northern United States and Canada east of the Rocky Mountains."

6. *ISCHNOPETRA INÆQUALIS* Sauss.—Zehnt.

Ischnoptera inæqualis Sauss.—Zehnt., 135, 1893, 36, Plate 6, Figs. 14-17; Scudd., 188, 1900, 7.

Male: "Fuscous or fusco-ferruginous, with brownish antennæ. Head with face testaceous; in middle and on vertex, black. Pronotum elliptical, with distinct impressions, the disk slightly convexed, smooth, wholly black or fuscous or castaneous, with lateral margins testaceous, translucent. Tegmina fuscous or slightly rufous in color, basal area with anterior margin hyaline. Wings subvitreous, with anterior and apical margins rather broadly infuscated. Vena ulnaris with six or seven branches; besides this, with incomplete branch and other rudimentary ones, not reaching the vena dividents.

Female: "Pronotum horny, parabolic, with anterior and lateral margins semi-elliptical, and the posterior margin transverse, broad, subangular, with lateral angles slightly rounded. Disk a little convex, with no impressions; fuscous-black in color, with yellow lateral margins. Tegmina abbreviate, covering first segment of the abdomen, blackish-fuscous in color with distinct veins, apex widely rounded and costal area yellowish in color. Wings rudimentary, yellowish, not covering medial segment, with apex fuscous or spotted."

Measurements: Length of body, male, 21 mm., female, 16 mm.; of pronotum, male, 5.2 mm., female, 5 mm.; of tegmina, male, 23 mm., female, 8 mm.; width of pronotum, male, 6.3 mm., female, 6.5 mm.; of tegmina, male, 6.8 mm., female, 5.2 mm.

Specimens from Crawford County, Indiana, were identified for me as this species by Prof. L. Bruner. I have since secured a copy of the description of Sauss.-Zehnt.—the only one extant—quoted above, with which the Indiana examples fairly agree. The species is very close to *I. pennsylvanica*, and may prove only a variety. The measurements are very nearly the same. The general color of the pronotum and tegmina is darker, approaching a fuscous. The pronotum is proportionally narrower in front, with the sides more distinctly deflexed and the sub-basal impressions more distinct. The females of the two are even more difficult to distinguish than the males.

The Crawford County specimens were taken in late June beneath flat rocks and chunks on high hills near Wyandotte Cave. Sauss.-Zehnt., like many other foreign systematists, give a very general range to the species they describe, recording this one from "North America, Texas, North Mexico."

7. ISCHNOPTERA MAJOR (Sauss.-Zehnt.)

Temnopteryx major Sauss.-Zehnt., 135, 1893, 54; Scudd., 188, 1900, 8.

Male: Size, large. Pronotum broadly elliptic, larger than in either of the two preceding species, membranaceous, the sides flaring, translucent; two deep oblique impressions on either side near the base. Tegmina membranaceous, hyaline, longer than abdomen. Wings as long as tegmina.

Female: Body, stout, broad. Pronotum, short and wide, horn-like, with no impressions; the hind margin nearly straight, the front margin rounded. Tegmina, abbreviated; covering only the basal segment of abdomen; rather broad, their inner edges overlapping, their apices broadly rounded. "Sulcus analis deep, scarcely curved anterior to the apex, reaching to three-fourths of the sutural margin." Wings very small, narrow, pointed. Supra-anal plate large, triangular, keeled, with apex bluntly rounded.

Color: Male, a nearly uniform, light reddish brown. Two basal joints of antennæ yellow, the remaining portion, as also the cerci, dark brown. Lateral margins of pronotum and of basal half of tegmina translucent whitish. Abdomen and legs pale yellowish brown. Female: Pronotum reddish brown, the lateral margins indistinctly yellowish or paler than the disk. Tegmina darker brown, their outer margins dull yellowish. Abdomen and cerci piceous. Antennæ as in male; the legs darker.

Measurements: Length of body, male, 21 mm., female, 17.5 mm.; of pronotum, male, 5.5 mm., female, 5.3 mm.; of tegmina, male, 21 mm., female, 6.5 mm.; width of pronotum, male, 6.3 mm., female, 7 mm.; of tegmina, male, 6.2 mm., female, 5 mm.

This roach has been taken in Indiana only in the vicinity of Wyandotte, Crawford County. Immature females were first found May 9, 1899, and mature individuals of the same sex on July 7th of that year. In 1902 more persistent searching proved the females to be common during the last week of June and the first one of July, several being taken with oötheca protruding. A single male, the only one seen, was secured on July 3d. There is little doubt but that it is one of the same species as the female, as it was found with two of them, and differs from any other roach taken in the State. It is of the exact color of *I. uhleriana* Sauss., described below, and is very likely to be taken for an unusually large form of that insect. It may be possible that it is a light form of *I. coulouiana* Sauss., of which the females are unknown, as it agrees very well, except in color, with the description of that species. If so, that name would have priority over *major*, of which the males have not hitherto been found. There is no

doubt of its being a true *Ischnoptera*. The female somewhat resembles that of the common *I. pennsylvanica*, but is broader bodied, with the front half not tapering. The yellow margin of pronotum and tegmina is much less distinct. The tegmina do not vary in length, as do those of the female *pennsylvanica*.

In the region mentioned *I. major* occurs beneath flat rocks on the sides and crests of the higher hills, especially in limestone glades where the red cedar abounds. It has heretofore been recorded only from Tennessee.

8. ISCHNOPTERA UHLERIANA Saussure.

Ischnoptera uhleriana Sauss., 128, III, 1862, 8; Id., 129, 1864, 82; Id., 132, VI, 1870, 55; Sauss.—Zehnt., 135, 1893, 36, Plate 3, Figs. 21-23; Scudd., 188, 1900, 7; Id., 189, IX, 1900, 100. (Male.)

Platanodes unicolor Scudd., 141, VII, 1862, 417; Fern., 53, 1888, 53.

Ischnoptera unicolor Brunn., 37, 1865, 134; Sauss., 133, VI, 1870, 56; Bl., 8, 1893, 160; Bent., 3, VI, 1894, 259; Lugg., 84, 1898, 97, Fig. 59; Scudd., 188, 1900, 8. (Male).

Tennopteryx virginica Brunn., 37, 1865, 86; Bent., 3, VI, 1894, 261; Scudd., 188, 1900, 8. (Female).

Male: Size, small, body narrow. Antennæ slender, tapering, slightly longer than the body. Pronotum, small, elliptical; the hind margin rounded, the sides somewhat deflexed, translucent; the impressions near base of disk, distinct, oblique. Tegmina fully developed, longer than the abdomen, rather wide. Wings as long as tegmina; the ulnar vein with five or six apical branches and several shorter ones. Supra-anal plate triangular.

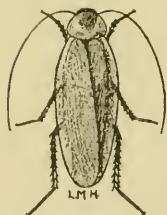


Fig. 27. *Ischnoptera uhleriana* Sauss. Male. (After Lugg.)

Female: Body broader than that of male. Pronotum semi-orbicular, sub-corneous, the hind margin nearly straight, the disk sub-convex, the impressions less distinct. Tegmina abbreviated, covering less than half the abdomen, their inner edges slightly overlapping, their apices rounded; usually slightly emarginate near the inner or sutural angle. Wings short and narrow, covering only first abdominal segment. Supra-anal plate triangular.

Color: Male, usually a uniform light reddish brown. Head and posterior margin of pronotum sometimes a little darker. Eyes, black. Wings, sub-vitreous, with reddish brown veins. Female, darker, the head, pronotum and usually the tegmina dark reddish brown, the

tegmina sometimes chestnut brown. Top of abdomen fuscous brown to piceous. Legs pale reddish brown.

Measurements: Length of body, male, 12 mm., female, 11 mm.; of pronotum, male, 3 mm., female, 3.3 mm.; of tegmina, male, 16 mm., female, 3.7 mm.; width of pronotum, male, 4 mm., female, 3.7 mm.

This light colored roach probably occurs throughout the State, having been taken in numbers in Crawford, Vigo, Putnam, Marion, Kosciusko and Lake counties. The males are often seen about electric lights in the cities; but when first reaching maturity about May 10, they are gregarious beneath the bark of logs and under chunks and rubbish in open woods. The females appear fewer in numbers, but are probably overlooked, their tegmina being so short that they resemble the nymphs of their own or other species.

The first record of the female in the State was made June 2, 1894, as follows: "In a flat woods, seven miles east of Terre Haute, I found a new species of cockroach quite common beneath the bark of oak stumps. The wings short, covering less than one-half abdomen. It may be the female of *I. unicolor* Scudd., as several of the long-winged forms of the latter were beneath the same shelter." Since then, I have usually found this short winged form in company with the males of *I. unicolor*; and have taken them with oötheca protruding in the first week of July. Some of the first ones taken were sent to Scudder, who pronounced them *T. virginica* Brunner, and they agree in all respects with the original description of that species, which was made from a single female, and of which the male is unknown. Since no female of *I. unicolor* has been described except by Sauss.-Zehnt. under the name of *I. uhleriana*, I believe the *T. virginica* to be the female of *I. unicolor*. Scudder, in *Psyche* (IX, 100), states that he has compared the types of *uhleriana* and *unicolor* and that they are identical. He had previously seen Indiana specimens of *unicolor* and pronounced them that species. Prof. L. Bruner has recently sent me specimens of both sexes of *uhleriana* from Nebraska under the name of *I. borealis* Brunn. It is very probable that that species is also a synonym of *uhleriana*, though only a comparison of the different types will decide. Brunner states that *I. unicolor* may be distinguished from *I. borealis* by the much lighter color and the disposition of the nerves of the wings; but the color varies much with age; while Saussure has shown that in certain species of *Ischnoptera*, the venulation of the wings is also very variable.*

* Miss. Scientif. Mex., p. 64.

9. ISCHNOPTERA INTRICATA sp. nov.

Female: Size, small; body, short and broad. Antennæ slender, about as long as body; the joints with numerous short hairs. Pronotum sub-orbicular, smooth, shining; the disk convex, its sides sloping; the hind margin straight or nearly so. Tegmina abbreviate, reaching only to second abdominal segment, their inner edges separated by a space equal to half their breadth; and gradually tapering obliquely on apical third to the sub-acute apex. Wings minute, narrow, reaching only to first abdominal segment. Abdomen notably broader than thorax; its width equaling two-thirds the total length. Supra-anal plate short, triangular, obscurely keeled; the preceding segment, smaller and more distinctly keeled. Subgenital plate broadly convex, entire.



Fig. 28. *Ischnoptera intricata* sp. nov. Female. One and one-third times natural size.

(Original.)

Color: A nearly uniform shining piceous; the outer margins of tegmina sometimes chestnut brown. Legs dark reddish brown; wings light brown.

Male: Size small, body narrow. Pronotum elliptical, sub-corneous, the lateral margins strongly deflexed; the hind margin but little convex; the disk with an irregular distinct depression on either side. Tegmina much longer than the abdomen, rather wide, the veins distinct.

Color, dark reddish brown to piceous, the tegmina and legs lighter. Antennæ light wood brown, the joints very hairy. Head and under side of thorax piceous. Pronotum reddish brown, the posterior margin darker. Tegmina and legs dull yellowish or golden brown. Under side of abdomen reddish brown.

Measurements: Length of body, male, 14.5 mm., female, 12 mm.; of pronotum, male, 3.5 mm., female, 4 mm.; of tegmina, male, 15.5 mm., female, 4 mm.; width of pronotum, male, 5 mm., female, 6 mm.; width of tegmina, male, 5 mm., female, 3.5 mm.

The single male which I refer to this species was taken beneath a flat rock on the slope of a high hill near Wyandotte, Crawford County, May 9, 1899. The females were found to be quite common in the same locality in the last week in June, 1902. Several females were also secured beneath chunks in oak woods near Lake James, Stenben County, on August 7th, two of which had oötheca protruding. I am by no means certain that the male belongs with the females; if not, the name applied will be referred to the latter sex.

V. BLATTELLA Caudell (1903).

The members of this genus have the body elongate; the head almost completely hidden by the pronotum, which is small and sub-orbicular; the eyes large and reniform, the ocelli more or less distinct. Antennæ setaceous, sparsely clothed with long hairs, unicolorous and much longer than the body. Tegmina and wings reaching to or beyond the tip of abdomen, membranaceous or slightly coriaceous. Inner wings with the ulnar vein undivided and without incomplete branches to the vena dividens. Supra-anal plate of male elongated, either triangular or broadly rounded, sometimes almost orbicular; sub-anal plate of the same sex with the styles rudimentary or wanting. Last abdominal sternite of the female, large, triangular, obtuse but not notched.

This genus is represented in Indiana by but one introduced species which is cosmopolitan in its range.

10. *BLATTELLA GERMANICA* (Linnæus). The German Cockroach. The Croton Bug. The Water Bug.

Blatta germanica L., 81, II, 1767, 688; Sauss., 132, VI, 1870, 28; Comst., 41, 1888, 93, Fig. 87; Fern., 53, 1888, 50, Fig. 20; Kell., 78, 1892, 108, Fig. 59; Lugg., 84, 1898, 90, Fig. 53; Scudd., 188, 1900, 8.

Ectobia germanica Scudd., 141, VII, 1862, 418; Pack., 104, 1869, 576, Fig. 569; Glov., 62, 1872, Plate 1, Fig. 4; Id., 63, 1874, 132, Fig. 3; Riley, 122, II, 1884, 171, Fig. 247; Id., 125, I, 1888, 68, 191.

Phyllodromia germanica Brunn., 37, 1865, 90; Pack., 104, 1883, 576, Fig. 569; Riley, 126, II, 1890, 266, Fig. 57; Bl., 8, 1893, 162; Id., 16, 1899, 204, Fig. 44; Beut., 3, VI, 1894, 258.

Ectobia (Phyllodromia) germanica Marl., 85, 1896, 92, Fig. 42; Id., 86, 1902, 10, Fig. 5.

Blattella germanica Caud., 40b, V, 1903, 234.

Ischnoptera bivittata Thom., 210, I, 1876, 250, Plate XXXVI, Figs. 1, 2.

This is one of the smallest and, at the same time, one of the most common of the Blattidæ known to occur in the State. The general color is yellowish brown, the females often darker; all the limbs much lighter than the body; the pronotum with two dark brown, longitudinal bands separated by a yellowish stripe. The tegmina and wings of the male extend to the end of abdomen, those of the female are a little longer. Antennæ dark brown, exceeding slightly the tips of the closed tegmina. The body of the male is longer and narrower than that of the female.

Measurements: Male—Length of body, 13 mm.; of tegmina, 10 mm.; width of body, 4 mm.; Female—Length of body, 10 mm.; of tegmina, 11 mm.; of antennæ, 13 mm.

The "Croton bug," so called because it made its appearance in New York City in numbers about the time the Croton Aqueduct was completed, is a native of Central Europe, but like the Oriental roach, has become cosmopolitan. It seldom if ever occurs in numbers in the country, but is one of the worst insect pests with which the inhabitants of the larger cities of the United States have to deal, and is found in every town of any size in Indiana. It is the most fecund of all the roaches and the seasons of mating and hatching of the young are, perhaps, more irregular than in any other species. Adult forms are evidently to be found at all seasons of the year, as I have taken them in December, April and October. It is not so much a lover of filthy surroundings as is the Oriental roach, and hence frequents more



Fig. 29. *Blattella germanica* L.; a, first stage; b, second stage; c, third stage; d, fourth stage; e, adult; f, adult female with egg case; g, egg case, enlarged; h, adult, with wings spread. All natural size except g.—From "Household Insects," published by U. S. Div. of Entomology.

often than that species the dwellings of the better class of people. It delights in warm, moist places, and is especially abundant and destructive in buildings which are heated by steam.

As an evidence of its abundance under favorable conditions, I will mention that a single person captured for me over thirty adult specimens and fully half that number of young, in less than ten minutes in the kitchen of the leading hotel of the city of Terre Haute. Where it once obtains a foothold and the surroundings of temperature and food supply are favorable, it is almost impossible to eradicate, as its small flattened form enables it to hide and breed in cracks and crevices which none of the other roaches can enter.

Like many other omnivorous animals, Croton bugs find in wheaten flour a food substance which is rich in nutrition and easily digested, and so they prefer wheat breads and starchy materials to all other foods. On account of this liking they often do much harm to cloth bound books by gnawing their covers in search of the paste beneath.

They also seem to have a peculiar liking for paints of various kinds, and in the office of the U. S. Coast and Geodetic Survey, at Washington, have done much damage by eating off the blue and red paints from the drawings of important maps. Glover, *loc. cit.*, states that in his office "They made a raid on a box of water colors where they devoured the cakes of paint, vermilion, cobalt and unber alike; and the only vestiges left were the excrements in the form of small pellets of various colors in the bottom of the box."

The oötheca of the Croton bug is very light brown, a little over twice as long as broad, 7.5x3.5 mm., with the sides somewhat flattened and the edges parallel. Within it the eggs, thirty-six in number, are arranged in the usual two rows. It is carried about by the mother roach for several days with from half to three-fourths of its length protruding from the abdomen, and when dropped in a favorable place the young, evidently very soon, emerge from it; for in a bottle in which a female with protruding oötheca was placed at eleven o'clock p. m. the young were found to have emerged on the following morning at eight. They were then wholly white, except the lateral edges of the abdomen, where a blackish tinge was evident. By five o'clock in the afternoon of the same day, having meanwhile eaten their fill of moistened wheaten bread, they had become too large for their skins, and had moulted for the first time. They then measured 3 mm. in length, and the head, pronotum, abdomen, and apical half of antennæ were black, while the other two thoracic rings and the basal half of antennæ were a grayish white. The half grown young are very dark brown, with the first four or five segments bordered with yellow, and with traces of a lighter median stripe.

In giving a remedy for this and other roaches I can not do better than to quote from Mr. Marlatt's excellent bulletin as follows:

"Like the crows among birds, the roaches among insects are apparently unusually well endowed with the ability to guard themselves against enemies, displaying great intelligence in keeping out of the way of the irate housekeeper and in avoiding food or other substances which have been doctored with poison for their benefit. Their keenness in this direction is unquestionably the inheritance of many centuries during which the hand of man has ever been raised against them.

"*Fumigation*.—A thoroughly effective and simple means of ridding one's premises of roaches has been found, however, and is in fumigating with hydrocyanic-acid gas. The experience of the last year or two has demonstrated that this gas, formerly employed for disinfecting nursery stock and orchard trees (notably citrus) from scale and

other insects, is equally effective against household insects, and is particularly applicable and satisfactory against all species of house roaches. The gas is extremely poisonous to human beings, but by observing the proper precautions, may be employed with complete safety. A special circular (No. 46, Second Series, U. S. Div. Ent.) has been prepared by Dr. L. O. Howard, giving the steps of the process in detail.

"In addition to the hydrocyanic-acid gas treatment noted above, two or three other forms of fumigation may be employed against house roaches. Wherever roaches infest small rooms or apartments which may be sealed up nearly air-tight, and also on shipboard, the roach nuisance can be greatly abated by the proper use of poisonous gases, notably bisulphide of carbon. This substance distributed about a pantry or room in open vessels, will evaporate, and, if used at the rate of one pound to every 1,000 cubic feet of room space, will destroy roaches. Unless the room can be very tightly sealed up, however, the vapor dissipates so rapidly that its effect will be lost before the roaches are killed. The hatches of ships, especially of smaller coasting vessels, may be battened down, a very liberal application of bisulphide of carbon having been previously made throughout the interior. If left for twenty-four hours the roaches and all other vermin will unquestionably have been destroyed. In the use of this substance it must be always borne in mind that it is violently explosive in the presence of fire, and every possible precaution should be taken that no fire is in or about the premises during the treatment. It is also deadly to higher animals, and compartments should be thoroughly aired after fumigation.

"Poisons and Repellents.—As just noted, roaches often seem to display a knowledge of the presence of poisons in food, and, notwithstanding their practically omnivorous habits, a very little arsenic in baits seems to be readily detected by them. In attempting to eradicate roaches from the Department storerooms, where cloth-bound books are kept, various paste mixtures containing arsenic were tried, but the roaches invariably refused to feed on them in the least. This applies particularly to the German roach, or Croton bug, and may not hold so strongly with the less wary and perhaps less intelligent larger roaches.

"A common remedy suggested for roaches consists in the liberal use of pyrethrum powder or buhach, and when this is persisted in considerable relief will be gained. It is not a perfect remedy, however, and is at best but a temporary expedient, while it has the additional disadvantage of soiling the shelves or other objects over which

it is dusted. When used it should be fresh and liberally applied. Roaches are often paralyzed by it when not killed outright, and the morning after an application the infested premises should be gone over and all the dead or partially paralyzed roaches swept up and burned. Flour of sulphur dusted about where roaches abound has proven very effective as a repellent.

"There are many proprietary substances which claim to be fairly effective roach poisons. The usefulness of most of these is, however, very problematical, and disappointment will ordinarily follow their application. The only one of these that has given very satisfactory results is a phosphorus paste, also sold in the form of pills. It consists of sweetened flour paste containing 1 to 2 per cent. of phosphorus, and is spread on bits of paper or cardboard and placed in the runways of the roaches. It has been used very successfully in the Department to free desks from Croton bugs, numbers of the dead insects being found in the drawers every day during the time the poison was kept about. It is also a repellent."

For no other insects have so many quack remedies been urged and are so many newspaper remedies published. Many of them have their good points, but the majority are worthless. In fact, rather than put faith in half of those which have been published, it were better to rely on the recipe which T. A. Janvier gives (in his charming article on "Mexican Superstitions and Folk-lore," published in a recent number of Scribner's Magazine) as current among the Mexicans:

"To Get Rid of Cockroaches.—Catch three and put them in a bottle, and so carry them to where two roads cross. Here hold the bottle upside down, and as they fall out repeat aloud three *credos*. Then all the cockroaches in the house from which these three came will go away."

Sub-family PERIPLANETINÆ.

The two Indiana members of this sub-family are our largest roaches. Both are introduced species which have become thoroughly naturalized, and one of them is better known than any of our indigenous or native forms. The main distinguishing character of the sub-family is that pertaining to the last ventral segment of the female, which is keeled or boat-shaped, and divided into two valves. The head is large, flattened or slightly concave and not wholly covered by the pronotum. The antennæ are setaceous, more or less pubescent, the joints obconic and very short. The tegmina and wings are variable in the different species, being fully developed, abbre-

viated, or wholly wanting. The sub-anal plate of the male is furnished with two small styles on its apical margin. In our species the first joint of the hind tarsi is as long as, or longer, than the other joints combined.

Two genera of the sub-family, each represented by a single species, occur in Indiana.

KEY TO GENERA OF INDIANA PERIPLANETINÆ.

- a. Tegmina of neither sex reaching tip of abdomen, those of the female much shorter. Distance between the eyes greater than length of last joint of maxillary palpus.....VI. *BLATTA*, p. 192
- aa. Tegmina of both sexes much surpassing the abdomen. Distance between the eyes less than the length of last joint of maxillary palpus.....VII. *PERIPLANETA*, p. 195

VI. *BLATTA** Linnæus (1758).

In this genus the eyes are farther apart than the scrobes or pits in which the antennæ are inserted. The tegmina of the female are very short in both sexes and their outer border is less rounded than in *Periplaneta*.

11. *BLATTA ORIENTALIS* Linnæus. The Oriental Cockroach. The "Black Beetle."

Blatta orientalis L., 81, I, 1758, 434; Harr., 72, 1862, 145, Fig. 66; Rathv., 109, 1862, 374, Figs. 4, 5; Caud., 40b, V, 1903, 234.

Periplaneta orientalis Burm., 40, II, 1838, 504; Brunn., 37, 1865, 226; Riley, 122, II, 1884, 172, Figs. 246, 248; Id., 126, II, 1890, 267; Comst., 41, I, 1888, 93; Fern., 53, 1888, 52, Fig. 21; Hyatt and Arms., 77, 1890, 102, Plate IV, Figs. 54, 55; Bl., 8, 1893, 156; Id., 16, 1899, 199, Fig. 41; Marl. 85, 1896, 91, Fig. 41; Id., 86, 1902, 9, Fig. 4; Lugg., 84, 1898, 92, Figs. 51, 54.

Kakerlac orientalis Serv., 196, 1839, 72.

Stylopyga orientalis Scudd., 141, VII, 1862, 416; Id., 188, 1900, 9; Glov., 62, 1872, Plate I, Figs. 5, 6; Plate VII, Fig. 12; Id., 63, 1874, 132, Fig. 4; Beut., 3, VI, 1894, 260, Plate V, Figs. 2, 3.

General color dark mahogany brown, the limbs lighter, the pronotum without a yellow margin. Female with rudimentary tegmina which do not exceed 5 mm. in length. Male with the tegmina and wings well developed, the former covering three-fourths of the abdomen, the latter almost as long. Supra-anal plate of the male truncate; that of the female rounded with a shallow notch at the end.

*Mr. A. N. Caudell has recently shown (Proc. Ent. Soc., Wash., V, 1903, 234), that *orientalis* L. is the type species of the genus *Blatta*; hence, the generic name *Blatta* is here used instead of *Stylopyga* of Scudder's Catalogue.

Measurements: Length of body, male, 22.5 mm., female, 27.5 mm.; of tegmina, male, 14 mm., female, 4.5 mm.; of pronotum, 6 mm.; width of pronotum, 8 mm.

In Indiana the Oriental roach is found in all the larger towns and cities, and is one of the most noisome and disagreeable insects with which certain classes of their inhabitants have to contend. It seldom occurs in houses in thinly settled localities, and never, as far as my observation goes, beneath the bark of logs and stumps.

As its name indicates, it is a native of Asia, but has been carried from one country to another by shipping. It delights in filth and darkness, and hence in the holds of vessels, the cellars and basements

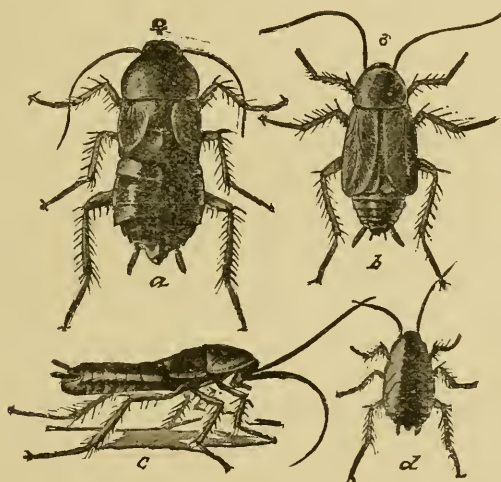


Fig. 30.—*Blatta orientalis*; a, female; b, male; c, side view of female; d, half grown specimen. All natural sizes. From "Household Insects," published by U. S. Div. of Entomology.

of tenement houses, and in all damp, dirty places it swarms by thousands, undoubtedly doing much good as a scavenger, but infinitely more harm on account of its omnivorous and insatiable appetite. Like most other members of the family, it feeds mainly at night, appearing to detest and avoid the light, as one can readily prove by taking a lighted lamp suddenly into its haunts, when a hurried scrambling will take place toward its daylight retreats, and but a few moments will elapse before the last of the busy marauders will have disappeared. Of this and other species Marlatt has written:

"The damage they do is not only in the products actually consumed, but in the soiling and rendering nauseous of everything with which they come in contact. They leave, wherever they occur in any

numbers, a fetid, nauseous odor, well known as the 'roachy' odor, which is persistent, and can not be removed from shelves and dishes without washing with soap and boiling water. Food supplies so tainted are beyond redemption. This odor comes partly from their excrement, but chiefly from a dark colored fluid exuded from the mouth of the insect, with which it stains its runways, and also in part, doubtless, from the scent glands, which occur on the bodies of both sexes between certain segments of the abdomen, and which secrete an oily liquid possessing a very characteristic and disagreeable odor. It frequently happens that shelves on which dishes are placed become impregnated with this roachy odor, and this is imparted to and retained by dishes to such an extent that everything served in them, particularly liquids, as coffee or tea, will be noticed to have a peculiar, disgusting, foreign taste and odor, the source of which may be a puzzle and will naturally be supposed to come from the food rather than from the dish."

The Oriental roach is probably the most carnivorous of all our Blattidæ, though, like most others, it is fond of starchy food. It is known to feed upon meat, cheese, woolen clothes, and even old leather, and is said to be especially fond of the festive "bed-bug," *Acanthia lectularia* L., which soon disappears from a house infested with the Oriental roach. This roach is, however, far too great a nuisance in itself to be introduced as a means of eradicating even the bed-bug.

The eggs of the Oriental roach are sixteen in number, and the large, horny capsule or oötheca in which they are packed is carried about by the mother for a week or longer when she drops it in a warm and sheltered place. Along one side of the capsule, which resembles in form and color a diminutive seed of the papaw, *Asimina triloba* DuRoi, is a seam where the two edges are cemented closely together. When the young are hatched they excrete a liquid which dissolves the cement and enables them to escape without assistance, leaving their infantile receptacle as entire as it was before they quitted it.

This species is notably gregarious in habit, the individuals living together in colonies in the most friendly way, the small ones being allowed by the larger ones to sit on them, run over them and nestle beneath them without a show of resentment. The young pass through a variable number, sometimes as many as seven, moults, the skin splitting along the back and the insect emerging white and soft, but soon hardening and assuming its normal color.

Besides the remedies given on a previous page for roaches in general, a simple trap has been tried by Mr. Marlatt which was fairly

successful in lessening the numbers of the Oriental roach. This "consists of any deep vessel or jar, against which a number of sticks are placed, and bent over so that they project into the interior of the vessel for a few inches. The vessel is partially filled with stale beer or ale, a liquid for which roaches seem to have a special fondness. In the morning these vessels are found charged with great quantities of dead and dying roaches which have climbed up the inclined sticks and slipped off into the vessel."

Another remedy which may be used for any of the household species is a mixture of plaster of Paris, one part, and flour, three or four parts, in a saucer, and placed where the roaches abound, with another flat plate nearby containing pure water, both supplied with several bridges to give easy access, and one or two thin boards floating on the water touching the margin. The insects readily eat the mixture, become thirsty and drink, when the plaster sets and clogs the intestines. The insects disappear in a few weeks, the bodies no doubt being eaten by the survivors.

VII. PERIPLANETA Burmeister (1838).

The members of this genus have the eyes closer together than the scrobes or pits of the antennæ. The tegmina of both sexes reach much beyond the abdomen, and the inner wings are as long as the tegmina.

But one species has as yet been taken in the State, though another may occur here, so that the following key is given for their separation:

KEY TO SPECIES OF PERIPLANETA.

- a.* Tegmina much exceeding the abdomen; their outer margin of the same color as the remainder of the wing. 12 *americana*, p. 195
- aa.* Tegmina but little exceeding the abdomen; a bright yellow stripe along the basal half of their outer margin. *australasæ*.

12. PERIPLANETA AMERICANA (Linnæus). The American Cockroach.

Blatta americana L., 81, I, 1758, 434; Rathv., 109, 1862, 375 (in part); Pack., 216, 1883, 309, Plates XXV-XXXV.

Periplaneta americana Burm., 40, II, 1838, 503; Scudd., 141, VII, 1862, 416; Id., 188, 1900, 9; Brunn., 37, 1865, 232; Glov., 62, 1872, Plate I, Fig. 2; Riley, 122, II, 1884, 172; Id., 125, I, 1888, 68, 190; Id., 126, II, 1890, 266; Fern., 53, 1888, 51; Bl., 8, 1893, 157; Id., 16, 1899, 202, Fig. 42; Beut., 3, VI, 1894, 259, Plate V, Fig. 4; Marl., 85, 1896, 90, Figs. 38, 39; Id., 86, 1902, 8, Figs. 1, 2; Lugg., 84, 1898, 93, Fig. 55.

Kakerlac americana Serv., 196, 1839, 68.

General color, light reddish brown. Pronotum broadly margined on the sides and narrowly in front with yellow, thus enclosing a large, bi-lobed brown spot. Tegmina and wings reaching much beyond the abdomen in both sexes. Supra-anal plate of female more pointed and median notch narrower and deeper than in *B. orientalis*.

Measurements: Length of body, male, 27 mm., female, 30 mm.; of pronotum, 8 mm.; of tegmina, male and female, 27.5 mm.; width of pronotum, 10.5 mm.

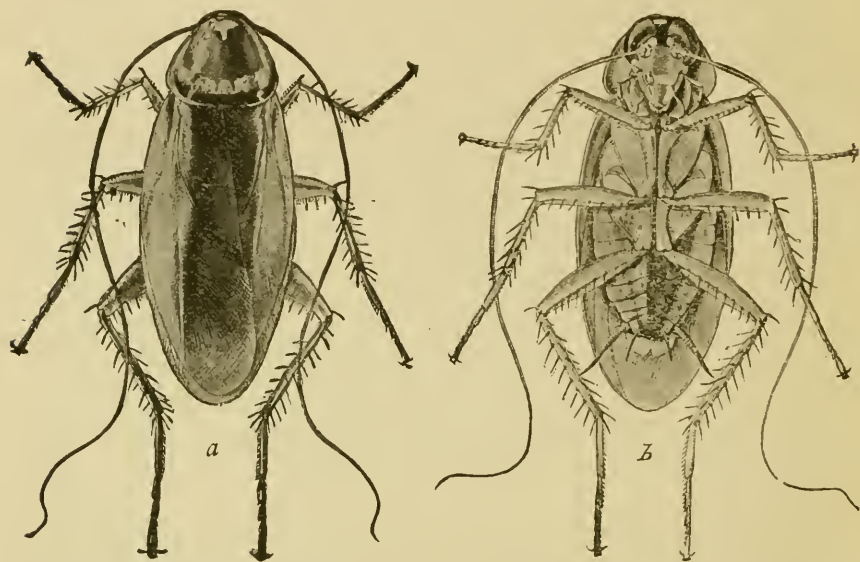


Fig. 31. *Periplaneta americana*; a, view from above; b, from beneath; both enlarged one-third. From "Household Insects," Published by U. S. Div. Entomology.

The American cockroach is, as its specific name indicates, a native of tropical and sub-tropical America; but, like *B. orientalis*, it has spread to the four corners of the earth. It is by far the largest species found in the State, but is much less common than *orientalis*, as I have specimens from but two counties, Putnam and Marion. It doubtless occurs, however, in all the larger towns of the State. It is found in numbers in some of the leading hotels of Indianapolis, but usually confines itself to the basement and first floor, and appears to be much more cleanly in its choice of an abiding place than does the closely allied Oriental roach.

Catesby, as far back as 1748, wrote of this species in Carolina as follows:

"The Cockroach.—These are very troublesome and destructive vermin, and are so numerous and voracious that it is impossible to keep victuals of any kind from being devoured by them without close covering. They are flat, and so thin that few chests or boxes can exclude them. They eat not only leather, parchment and woolen, but linen and paper. They disappear in winter and appear most numerous in the hottest days in summer. It is at night they commit their depredations, and bite people in their beds, especially children's fingers that are greasy. They lay innumerable eggs, creeping into the holes of old walls and rubbish, where they lie torpid all the winter. Some have wings and others are without—perhaps of different sexes."*

Catesby's wingless examples were in all probability the young, as, like most other insects, the wings are not acquired until the final moult. Marlatt says that the "domesticity of the American roach resulted from ages of association with the aborigines. It has now become thoroughly cosmopolitan, and is unquestionably the most injurious and annoying of the species occurring on vessels. It is sometimes numerous also in greenhouses, causing considerable injury to tender plants. It is a notorious house pest, and occasionally vies with the German roach in its injuries to book bindings. The backs, sometimes entirely, of both cloth and leather bound books, are eaten off to get at the starchy paste used in the binding."

The young of the American roach require about a year to reach maturity. The rate of growth of it and other species depends, however, largely on the food and temperature conditions, and under unfavorable circumstances the nymph stage is much prolonged. "The abundance of roaches is, therefore, apparently not accounted for so much by their rapidity of multiplication as by their unusual ability to preserve themselves from ordinary means of destruction and by the scarcity of natural enemies."

PERIPLANETA AUSTRALASIE Fab. The Australian Roach.

This species will doubtless be found to inhabit the State, as it has been recorded from Florida, Nebraska and Minnesota. It is a little smaller than *P. americana*, from which it can be separated by the characters given in the key. Like the last two species, it inhabits houses, and in the Southern States it is more abundant and troublesome than either of them.

* Natural History, Carolina, 1748, Vol. II, p. 10.

Family MANTIDÆ.

This family is composed of elongate, slow moving insects, the most noticeable character of which is the possession of a long, slender prothorax with the first pair of legs so modified as to be fitted for grasping and holding their prey. The old name given to the group was therefore *Raptoria* or graspers. The head is large, oblique, loosely joined to the prothorax in such a manner as to be freely movable; the antennæ are slender, and rarely as long as the body. The ocelli are present and three in number. The pronotum is longer than any other segment. The abdomen of the female is much broader than that of the male, and is without a visible ovipositor. The fore-legs are stout, raptorial and terminate in a single claw which, with the five-jointed tarsi, is placed in a groove on the under side of the spinous tibiæ when at rest. The middle and hind pairs of legs are long, slender, and fitted for slow motion. Tegmina and wings are present, but in the female are often abortive. As with the other non-saltatorial families, ears and organs for producing sound are absent.

The members of this family have numerous popular names, the most common of which is the "praying mantid," given them on account of the position which they take when at rest or when waiting to grasp another insect. The knees are then bent, and the front legs held as though in supplication. In the Southern States they are often called "mule killers," from the common belief that the brownish liquor which they give off from the mouth is fatal to mules. This name is, however, often also applied to the "whip-scorpion," a large member of the order *Arachnida*, which inhabits the Southern States. The mantids are all carnivorous, feeding principally upon the different forms of other insects. They are thus in the main beneficial, in this respect differing widely from all other members of the order Orthoptera, unless it be the tree crickets of the genus *Ecanthus*, which feed upon plant lice. They capture their prey by stealth, crawling upon it very slowly, and when within reaching distance, seizing it with a sudden and rapid movement. Like other predatory insects, they have very voracious appetites. A member of a European species, *Mantis religiosa*, which was introduced on nursery stock in New York State, was observed to eat, in one day, three large grasshoppers and a daddy-long-legs and then tackled another mantis from which he was separated with difficulty. The eggs of mantids are laid in a curiously formed egg case or "ootheca," which is secreted by the female.

Only two of the six known sub-families are represented in the United States, and one of these only by a single genus and species along the southern border. The other is the

Sub-family MANTINÆ.

The insects belonging to this sub-family have the upper surface of the middle and fore femora and tibiæ rounded, instead of carinate. The head is unarmed, whereas, in the other sub-family, the *Vatinæ*, it bears on the middle an erect process, as long as the rest of the head. To the *Mantina* belong eleven known genera and sixteen species from the United States. Of these two species, belonging to different genera, have been taken in Indiana.

KEY TO GENERA OF INDIANA MANTINÆ.

- a.* Broadest portion of pronotum far in advance of the middle; the sides in front distinctly tapering. Fore femora armed on the lower outer margin with large spines only. VIII. STAGMOMANTIS, p. 199
- aa.* Broadest portion of pronotum but little, if any, in advance of the middle; the sides in front parallel, or nearly so. Fore femora armed on the lower outer margin with minute spines between the large ones. IX. GONATISTA, p. 201

VIII. STAGMOMANTIS Saussure (1869).

Body of male narrow, of female much broader. Head large, compressed, triangular. Antennæ short and fine, inserted about the middle of the face below the center of the eyes. Vertex narrow, transverse, a little elevated above the eyes. Pronotum very long, in our species forming two-fifths the whole body; the apical third wider, the edges carinate and armed with minute, distant teeth. Tegmina of female shorter than abdomen, opaque and bearing a distinct spot or stigma of different texture near the center. Tegmina of male, in our species, longer than abdomen with stigma often indistinct or wanting. Wings of the female, when expanded, of the form of a quarter circle; those of the male longer and narrower. Abdomen of female, large, more or less dilated; that of male narrow, the sub-genital plate large.

Two species occur in the United States, one of which is found in the southern half of Indiana.

13. *STAGMOMANTIS CAROLINA* (Linnæus). The Carolina Mantis. The Rearhorse.

Gryllus carolinus L., 80, 1763, 13.

Mantis carolina L., 81, II, 1767, 691; Rathv., 109, 1862, 376, Figs. 8-10; Riley, 113, I, 1869, 169, Figs. 94, 95; Id., 216, III, 1883, 37, Figs. 19ab; Id., 124, X, 1887, 44, Figs. 20ab; Glov., 62, 1872, Plate II, Figs. 1-16.

Stagmomantis carolina Sauss., 130, III, 1869, 65; Id., 131, 1871, 46; Id., 132, VI, 1872, 247, Plate V, Fig. 5; Plate VI, Fig. 12; How., 74, IV, 1892, 243, Figs. 29, 31; Id., 76, 1901, 326, Figs. 215, 216; Scudd., 173, XXVIII, 1895, 210; Id., 188, 1900, 12; Bl., 13, XXVIII, 1896, 265; Id., 16, 1899, 209, Fig. 46.

Phasmomantis carolina Riley, 122, II, 1884, 173, Fig. 249.

Color: Male, grayish brown. Tegmina semi-transparent, grayish, more or less mottled with smoky brown; sometimes almost wholly of the latter color. Body and feet often greenish yellow. Female, either wholly green or of the color of the male; the stigmatic patch black bordered with pale yellow, more distinct in the green form.



Fig. 32. *Stagmomantis carolina* L. Female.

Measurements: Length of body, male, 49 mm., female, 52 mm.; of pronotum, male, 17 mm., female, 20 mm.; of tegmina, male, 32, mm., female, 23 mm.

This mantid is a species of southern range and in Indiana occurs only in the south half, being quite common in the counties bordering the Ohio River. It extends as far north as Marion and Putnam counties, where it is found sparingly. I have taken it in Floyd, Perry and Lawrence counties, and have had a dozen or more specimens brought to me in Indianapolis, all of them females. Mr. S. G. Evans, of Evansville, in a letter says: "The Mantids are found here of all sizes and colors, the eggs and young being almost as common as mosquitoes. I have, on several occasions, placed male and female together in a glass jar, and the female always devoured the male, and generally while in the act of copulating, the bodies remaining together until the male was almost consumed." At Indianapolis the females evidently reach maturity about September 1st, most specimens being brought in about that date or later. The green and

brown forms of the female are about equally numerous. In Putnam County it has been noted by Mr. John S. Michaels near Bainbridge.

When in the presence of its prey the Carolina mantis moves almost imperceptibly along, stealing toward its victim like a cat approaching a mouse. When sufficiently near, the foreleg is suddenly extended to its full length and the unlucky insect is immediately caught and impaled by the spines between the tibiae and tarsi, carried to the mouth and deliberately eaten piecemeal while yet alive and struggling to escape. When the two sexes are captured and placed together the female soon begins to feed upon her liege lord, and finally devours all portions of him which are in the least degree digestible.

The eggs of the Carolina mantis are laid in tough cases about an inch long which are attached to the twigs of trees. The case is tough and horny, and the eggs are laid in parallel rows, perhaps forty in a row, issuing from a common longitudinal middle line. All of the eggs stand on end and are inclined somewhat toward the central channel. A cluster of eggs has a braided appearance, but consists simply of a continuous ribbon of mucus folded in close flutings and having an egg deposited in the bight or angle of each fold. The eggs are deposited simultaneously with the deposition of this ribbon by the mother insect, and the whole mass is at first soft and flexible, but rapidly hardens by exposure to the air. In this manner the species survives the winter and in May, when insect life begins to abound, the young emerge and use their prominent, staring eyes to good advantage in seeking plant lice and other minute forms which furnish them their first of many meals. The eggs are frequently parasitized by a very peculiar chalcis fly, *Podagrion mantis* which penetrates the tough egg mass with its long ovipositor, and whose larvæ feed upon the eggs. Thus egg masses taken by the observer in the winter and kept for the hatching of the young will frequently in the spring give out those parasites instead of the young mantids.

IX. GONATISTA Saussure (1869).

Body short and broad. Head short, compressed. Antennæ inserted opposite the base of the eyes, hair-like, of considerable length. Eyes very large, globose, prominent. Ocelli large in the male, smaller in the female. The face, in appearance, somewhat excavated on account of the prominence of the eyes. Crest of vertex a straight transverse line a little elevated above the eyes. Pronotum of medium length and breadth; the disk depressed, but with an elevation or

hump on the front and middle thirds with a depression between and with two small tubercles on the hind margin; widest about the middle; the front margin truncate; the sides of the front half parallel, those of posterior half a little converging. Tegmina of female broad, covering three-fourths of abdomen; the reticulation dense and irregular; the stigma small, narrow, often indistinct. Those of male narrower; surpassing the abdomen, more membranaceous. Wings ample, about as long as tegmina; those of the female forming a quarter of a circle, colored; those of male transparent or a little spotted. Fore limbs rather stout, the tibiae with five or six large spines on the lower outer border, with numerous small ones intervening; the inner border with twelve or more strong spines. Abdomen depressed, of medium width in the male; large and broad in the female, the border coarsely serrate or lobed.

One species is known from the southern United States and West Indies.

14. GONATISTA GRISEA (Fabricius). The Grizzled Mantis.

Mantis grisea Fab., 52, II, 1793, 22.

Gonatista grisea Sauss., 131, 1871, 23; Id., 132, VI, 1872, 231, Plate 5, Figs. 1, 2; Scudd., 173, XXVIII, 1896, 211, 214; Id., 188, 1900, 13; Bl., 13, XXVIII, 1896, 265.

Mantis pluryganooides Serv., 196, 1839, 198.

Gonatista cubensis Sauss., 130, III, 1869, 61.

Color: Female, grayish, more or less mottled with fuscous. The tegmina with two oblique fuscous crossbars on apical half. Inner wings bluish black. Fore legs gray tinged with greenish and sprinkled with fuscous. The middle and hind legs with narrow fuscous crossbars.

Measurements: Female, length of body, 36 mm.; of pronotum, 11 mm.; of tegmina, 20 mm.

A single female of this southern mantid was taken in Vanderburgh County by Mr. S. G. Evans and by him sent to the Agricultural College of Michigan, from which it came into my possession. Mr. Evans writes that he must have supposed it to be a short bodied form of *Slagmomanlis carolina* and has no recollection of the exact date, or the place in the county in which it was found. It may possibly, therefore, have been introduced on tropical fruits. It is common in Cuba and San Domingo and has been taken in Georgia and at Key West and Fernandina, Florida.

Family PHASMIDÆ.

To this family of non-saltatorial Orthoptera belong the insects commonly known as "walking-sticks." The body is long and exceedingly slender; the head nearly horizontal, not covered by the pronotum and usually quadrate or four sided; the antennæ long and rather coarse; the eyes small; the ocelli often wanting. The pronotum is very short. The tegmina and wings are wanting in our species, though present and rudimentary in some tropical forms. The legs are long, slender and of equal size, the fore femora being often bowed and the fore tarsi terminating, like the others, in a pair of claws.

Our species of *Phasmidæ* are remarkable for their resemblance to twigs of different plants; while some of the tropical species are so modified as to resemble leaves; frequently bearing so close a resemblance to the foliage as to deceive a keen observer. Their movements are, in general, very slow, though the males can run with some rapidity when in pursuit of the opposite sex. They feed during their entire lives upon leaves, being especially fond of those of oak and wild cherry. The eggs are dropped loosely and singly upon the ground by the mother, where they remain through the winter, thus tiding the insect over the cold season. The outer case or shell of the egg is hard and often sculptured, and those of our common species resemble small beans. The young, when hatched, trust to chance and their peculiar shape to escape those higher animal forms which are ever ready to prey upon every moving object which promises them a bit of sustenance.

The family is, in the main, a tropical one, and is very feebly represented in the United States, where but four of the dozen known sub-families are represented by seven genera and sixteen nominal species. Two of these sub-families are each represented in Indiana by a single genus and species.*

KEY TO SUB-FAMILIES OF PHASMIDÆ OCCURRING IN INDIANA.

- a. Tibiæ not furnished at apex with a short sunken space to receive the base of the tarsi when bent upon them. Mesothorax never less than four times as long as the prothorax, generally more. Hind femora armed beneath near the apex with one or more spines.
BACUNCULINÆ, p. 204
- aa. Tibiæ furnished on the under side at apex with a short, sunken space to receive the base of the tarsi when bent upon them. Mesothorax never more than three times as long as the prothorax, generally less. Hind femora without spines. ANISOMORPHINÆ, p. 207

*Mr. A. N. Caudell has recently published a monograph of the U. S. species of Phasmidæ in the Proceedings of the U. S. National Museum, XXVI, 1903, the nomenclature of which I have followed.

Sub-family BACUNCULINÆ.

This sub-family comprises the longest and most slender of the United States walking-sticks. The mesothorax is usually five or more times as long as the prothorax. The antennæ, except in the genus *Sermyle*, are more than twice as long as the front femora. The tibiæ are without a sunken areola beneath the apex.

Four of the United States genera belong to this sub-family. Of these, two are represented only in the Gulf and adjoining states; and a third only in the Rocky Mountain Region and California. The species of the other genus, *Diapheromera*, are widely distributed. Among them belongs our most common Indiana "walking-stick."

X. DIAPHEROMERA Gray (1835).

Body long, slender and cylindrical. Head smooth, longer than broad; obliquely attached to the thorax; the eyes small. Antennæ inserted in front of the eyes, more than twice as long as fore femora, furnished with 30 or more segments. Pronotum about the length of head. Mesonotum longer than any other segment; metanotum three-fourths the length of the mesonotum. Median segment much shorter than metanotum, transverse, quadrate. Legs very long and slender, the femora of the middle pair in the male of our species much swollen; armed, like those of hind pair, on under side near the apex with an acute spine, most prominent in the male. Cerci of the male long, terete and incurved; those of the female short, straight.

Five species occur in the United States, of which the most common and widespread is

15. DIAPHEROMERA FEMORATA (Say). The Thick-thighed Walking-stick.
Spectrum femoratum Say, 138, II, 1824, 297; Id., 137, III, 1828, Plate 27; Id., 139, 1859, I, 82, 197, Plate 37; Emms., 49, V, 1854, 142, Plate 7, Figs. 1, 2; Rathv., 109, 1862, 377, Fig. 11.
Diapheromera femorata Harr., 71, 1841, 119; Id., 72, 1862, 146, Fig. 67; Pack., 104, 1869, 573, Fig. 566; Glov., 62, 1872, Plate I, Fig. 7; Plate X, Fig. 1; Id., 63, 1874, 134, Fig. 6; Scudd., 148, I, 1874, 379, Plate A, Fig. 3; Id., 172, XXVII, 1895, 30; Id., 169, LXXXVIII, 1894, 456, 460; Id., 178, VIII, 1897, 30; Id., 188, 1900, 14; Id., 191, IX, 1901, 187; Riley, 120, 1878, 241, Plate 3, Figs. a-c; Id., 122, II, 1884, 176, Fig. 253; Comst., 41, 1888, 95, Fig. 91; Id., 42, 1895, 108, Fig. 118; Fern., 53, 1888, 49, Fig. 19; Bent., 3, VI, 1894, 262, Plate 10, Fig. 10; Weed., 222, 1897, 6, Plate 5; Lugg., 84, 1898, 100, Fig. 61; Bl., 16, 1899, 208, Fig. 45; How., 76, 1901, 323, Fig. 214; Caud., 40^a, 1903, 874, Figs. 4, 6.

Color variable, being either gray, brown or greenish brown. The body of the male is usually greenish brown, sometimes almost wholly green; the head yellowish with three lengthwise fuscous stripes; the front legs and the tibiae of the others usually green. The female is duller, generally grayish brown, often with paler specks and mottlings on the head and back.

The male is easily distinguished by the shorter and more slender body; longer legs and antennae; the narrower and less dilated front femora; the swollen middle femora and by the greater stoutness of the spines near the ends of the middle and hind femora.

Measurements: Length of body, male, 70 mm., female, 77 mm.; of antennae, male, 65 mm., female, 45 mm.; of hind femora, male, 21 mm., female, 16 mm.

The thick-thighed walking-stick is a rather common insect throughout the State, though the average observer will probably see but one or two of them a year. They reach maturity in August, and may often be found upon the leaves of oak or wild cherry, especially on isolated trees along fence rows. One of my students at Terre Haute once brought in on October 15th, 100 or more which he had gotten from a wild cherry tree on whose leaves they had been feeding. It moves very slowly and has a habit of remaining motionless and apparently dead for a considerable length of time. On such occasions it usually stretches itself out from a twig, with its front legs and antennae extended, and then can scarcely be distinguished from a prolongation or branch of the twig. Many people who see them thus for the first time and afterwards watch them moving slowly away, can scarcely be persuaded that they are not real twigs, gifted in some mysterious manner with life and motion.

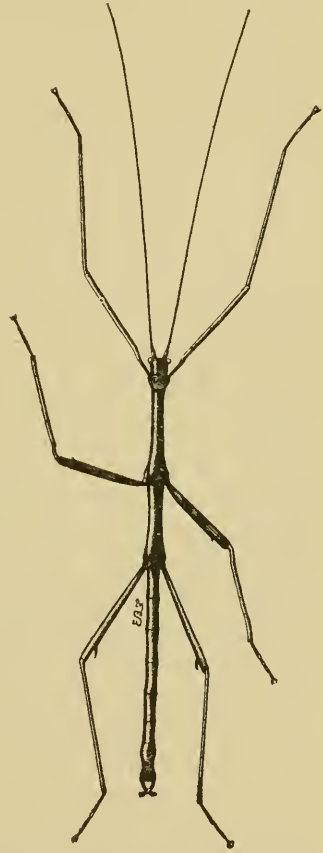


Fig. 33. *Diapheromera femorata* (Say).
Male.

In feeding, they eat the edges of a leaf, preferably those of an oak or wild cherry, usually straddling it with their legs, and in an hour will devour a piece an inch long by a third of an inch wide. Riley records that on occasions they are so numerous as to do much damage to oak, hickory, locust and other trees. In Yates County, New York, in 1878, Dr. Riley found them very abundant in a woodland of 50 acres, which they had attacked in numbers two and four years previously. He states that: "By the middle of August the bulk of the pests were going through their last moult, and by the end of autumn they had stripped most of the trees, showing, however, a decided preference for the black, red and rock-chestnut oaks, over the white oaks and hickories, which they affect but little until after the first mentioned trees are stripped. The underbrush was also very effectually cleaned of its foliage, and the insects hung from and clung to the bare twigs and branches in great clusters. They settle to roost on the witch-hazel, but do not defoliate it until the other trees mentioned are pretty bare. Sumach and thorn are also little affected, while peach and apple in an adjoining orchard were untouched. Whenever they have entirely stripped the trees and shrubs they move in bodies to fresh pastures, crowding upon one another and covering the ground, the fence rails, and everything about them so that it is impossible for a person to enter the woods without being covered by them. The timber affected can be recognized by its seared and leafless appearance from a great distance, and upon entering the woods the ear is greeted by a peculiar seething noise, resulting from the motion of the innumerable jaws at work on the leaves. Their depredations first begin to attract attention soon after wheat harvest, and are most noticeable in September. The injury to the trees done in 1874 and 1876 was manifest in the death of most of the black oaks, and, according to the owner's observations, trees die in three years after the first attack."

The eggs, of which each female lays about 100, are a little less than 3 mm. in length, long oval in shape and of a polished black color with a whitish stripe on one side. They resemble a small, plump bean or seed of other leguminous plant. "They are simply dropped loosely upon the ground from whatever height the female may happen to be, and, during the latter part of autumn where the insects are common, one hears a constant pattering, not unlike drops of rain, which results from the abundant dropping of these eggs, which in places lay so thick among and under the dead leaves that they may be scraped up in great quantities. From general observations of specimens kept in confinement, it would appear that each female is

capable of laying upwards of 100. The eggs remain upon the ground all through the winter and hatch for the most part during the month of May. Some of them, however, continue hatching much later, so that all through the summer and even into the fall, young individuals may be found. The insect changes very little in appearance from birth to maturity except so far as color is concerned, and moults but twice. Growth is rapid, averaging, under favorable circumstances, about six weeks from birth to maturity. With age the green color gives way to various shades of gray and brown. In this way we find great correspondence with its surroundings. While the vegetation is green, the walking sticks are green also; when the foliage turns in autumn, they change color correspondingly, and when the foliage is stripped they so closely resemble, in both appearance and color, the twigs upon which they rest—the habit of stretching out the front legs and feelers greatly enhancing the resemblance—that when they are few in number it is difficult to recognize them. A few green specimens, more particularly of the males, may always be found, even among the mature individuals.”

This Walking-stick appears to be abundant in any certain locality only every other year. This is in part due to an increase of the insect's natural enemies on those years in which they are most abundant. These enemies are several species of true bugs (*Hemiptera-Heteroptera*) crows and other birds. The main reason for the greater number of Walking-sticks on alternate years is, however, thought to be due to the fact that the larger proportion of the eggs, especially those laid late in the autumn, take two years in hatching. If at any time the insect threatens to become injurious in the woodlands of the State, it can be held in check by burning the leaves on the ground in the winter season, thus destroying the hibernating eggs.

Sub-family ANISOMORPHINÆ.

In this sub-family the antennæ are more than twice as long as the anterior femora. The tibiæ are furnished with a sunken areola beneath the apex, which receives the base of the tarsi when bent; coxæ visible from above; tarsi distinctly five-jointed. Mesothorax not more than three times as long as the prothorax. Intermediary segment invisible.

A single genus of this sub-family is represented in the United States.

XI. ANISOMORPHA Gray (1835).

Body of male elongate, slender; that of the female much larger and more robust. Head short, quadrate, horizontally attached to the thorax; and eyes larger than in *Diapheromera*. Antennæ shorter and stouter than there, though longer than the fore femora; the basal joint but little longer and little stouter than the second. Pronotum the length of the head. Mesonotum twice as long as pronotum and a third longer than metanotum. Front segments of abdomen but little longer than broad. Legs of nearly equal length, stout and thick, shorter than in the preceding genus, unarmed. Cerci of both sexes short, stout, cylindrical, projecting a little from beneath the large supra-anal plate.

Two species occur in the southern United States, one of which extends northward into Indiana.

16. ANISOMORPHA FERRUGINEA (Palisot de Beauvois). The Lesser Two-striped Walking-stick.

Phasma ferrugineum Pal. de Beauv., 108, 1805-1821, 167, Plate XIV, Figs. 6-7.

Anisomorpha ferruginea Gray., 64, 1835, 18; Burm., 40, II, 1838, 570; Scudd., 172, XXVII, 1895, 30; Id., 188, 1900, 15; Candell 40^a, XXVI, 1903, 880, 882, Plate LIX, Fig. 2.

Color: Fuscous or ferruginous, inconspicuously striped with narrow dusky dorsal and lateral stripes; these in the female less distinct, and often obsolete on a portion of the abdomen. Antennæ dull reddish brown. Under side of body dull clay yellow, brownish when dried. Legs brownish red.

Head but little longer than broad. Body of female six to six and a half times longer than broad; of male, about twelve times as long as broad.

Measurements: Length of head, male, 3 mm., female, 5.5 mm.; of body, male, 30 mm., female, 56 mm.; of antennæ, male, 22 mm., female, 34 mm.; of hind femora, male, 9 mm., female, 12 mm.

This southern Walking-stick has been taken in Indiana only near Wyandotte, Crawford County, and Grand Chain, Posey County, being found in large numbers in both localities. The first ones taken were in Crawford County, on June 28, 1902, when the young about an inch and a half long were found beneath loose flakes of bark on oak and other trees. In the first week in September I again visited the locality and found scores of pairs of them, all mating, beneath the loose bark of old oak snags and stumps. A half-dozen or more

pairs were often found within an area of a foot or two square, the large, heavy bodied female bearing her diminutive liege lord upon her back.

When picked up by the fingers, there is exuded from glands on the sides of the thorax a vapor from the male and a white milky fluid from the female. This possesses a peculiar, though somewhat pleasing odor, which has been likened to that of the common Everlasting, *Gnaphalium obtusifolium* L. The secretion is doubtless used as a de-

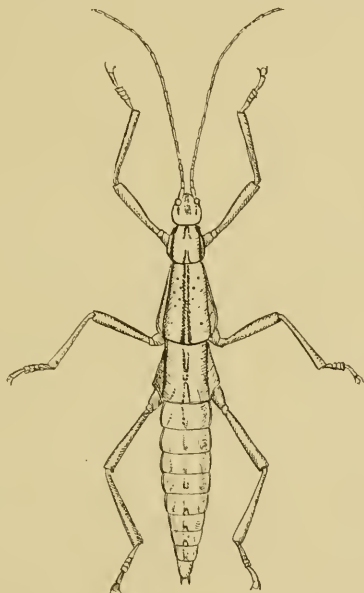


Fig. 34. *Anisomorpha ferruginea* (Pal de Beauv). Female.
Natural size. (After Caudell.)

fense against certain enemies, being probably very distasteful, and perhaps harmful, to birds and rapacious insects. Scudder (*Psyche* I) has noted this secretion, and concludes that the *Phasmidae* with their slender form and sluggish movements have especial need of such a weapon as these glands furnish.

None of the specimens of *ferruginea* noted were feeding, though they probably live upon the leaves of oak and other trees. The species was later found in numbers in Posey County, and probably occurs in most of the counties bordering the Ohio River. It is but one of many forms of insect and plant life which have their most northern habitat in the southern third of Indiana. Specimens in the U. S. National Museum are from Florida, Louisiana, Kentucky and Pennsylvania.*

* Since the above was in type *a ferruginea* has been taken as far north as Medora, Jackson County.

SALTATORIA.

Belonging to this class or sub-order, are three families which comprise the great majority of our best known Orthoptera. They are the true "hoppers" or leapers of the order; their hind limbs, in the course of ages, having become so modified as to be adapted in the highest degree to the life which they lead. Possessing, also, in many instances, ample organs of flight, which enable them, when disturbed, to move rapidly to a distance, the males have evolved in connection therewith organs of sound, by which they may call the members of the opposite sex to them. Were it not for these calling organs the two sexes would, during their varied movements, often be widely separated, and perhaps be unable to locate one another after settling in a new position. The males alone possess these organs of sound, and they only when wings are present. All the wingless forms lack also "auditory organs" or ears, since these would be useless unless some means of producing sound were present. The families belonging to this group may be separated by the following table:

KEY TO FAMILIES OF SALTATORIAL ORTHOPTERA.

- a.* Antennæ much shorter than the body, variable in form. Ocelli three. Tarsi three-jointed. Calling organs of male, when present, situated on the hind femora and lower border of tegmina. Organs of hearing, when present, located on the basal segment of the abdomen. Ovipositor composed of two pairs of short, horny, more or less curved plates, whose tips diverge.....ACRIDIDÆ, p. 211
- aa.* Antennæ much longer than the body, bristle shaped, delicately tapering. Ocelli often wanting. Tarsi four or three-jointed. Calling organs of male, when present, situated on the dorsal field of the tegmina. Organs of hearing, when present, located near the base of the fore tibiæ (rarely on the prosternum). Ovipositor (except in certain crickets) an elongated blade or needle; its parts compact.
 - b.* Ocelli generally wanting. Tarsi four-jointed. Tegmina with the sides sloping. Calling organ of male, when present, located on basal half of tegmina and limited to the anal area. Ovipositor, when exerted, forming a strongly compressed, generally sword-shaped blade, the tip not expanded.....LOCUSTIDÆ, p. 340
 - bb.* Ocelli variable. Tarsi three-jointed. Tegmina flat above, the sides bent abruptly downward. Calling organ of male, when present, extending across both anal and median areas of the tegmina. Ovipositor, when exerted, forming a nearly cylindrical straight or upcurved needle, the tip often enlarged.....GRYLLIDÆ, p. 407

Family ACRIDIDÆ.

To this family of saltatorial Orthoptera belong those short-horned grasshoppers or locusts which are so common in our meadows and pastures and along our roadsides from mid-April until after the heavy frosts of late autumn. Their antennæ are, with few exceptions, much shorter than the body, filiform, clubbed or ensiform in shape, the joints distinct, and often, especially toward the base, depressed. The head is usually short, and in the leading sub-families is extended horizontally. Ocelli are always present, and foveola usually so, the variations in form and size of the latter affording characters much used in classification.

The pronotum is variable in form and size, but in most species forms a buckler or saddle-shaped shield covering the three segments of the thorax. In one sub-family, the *Tettiginæ*, it extends back over the abdomen. The tegmina and wings, when present and in repose, rest partly horizontal on the dorsal surface of the abdomen and partly reflexed against its sides. The auditory or hearing organ, when present, is located on the side of the basal ring of the abdomen. The anterior and middle legs are equal or nearly so in size, and much smaller and shorter than the hind legs; the femora of the latter being, as in the other *Saltatoria*, very much enlarged in their basal halves. The tarsi are three-jointed and similar in structure on all the legs; the first joint, usually the longest, has the under side marked with two cross impressions which, when seen from below, give the impression that it is composed of three segments. The third or apical segment of the tarsus ends in a pair of curved claws which enable the insect to catch and cling to blades of grass and other objects on which it may alight. Between these claws there is in the species of all the sub-families except those of the *Tettiginæ* a circular pad or cushion, called the pulvillus or arolium. The ovipositor consists of four short, horny pieces, the so-called valves, projecting from the tip of the abdomen, two of which curve upward and two downward.

The call notes made by the males of the *Acrididæ* are produced in two ways. In one group, whose members call only when at rest, the sound is produced by rubbing the inner surface of the hind femur against the outer surface of the tegmina. Landois has shown that in this group, the inner surface of the femur is furnished along the lower margin with a longitudinal row of minute, lancet-shaped, elastic teeth, ranging in number from 85 to 93, which are scraped across the veins of the tegmina, thus producing a low, buzzing sound. Those

which stridulate in this manner mostly belong to the sub-families *Tryxaline* and *Aceridinæ*.

The members of the sub-family *Edipodinæ* usually sound their call during flight by rubbing together the upper surface of the front edge of the wings and the under surface of the tegmina, thus pro-



Fig. 35. Inside of hind femora of a locust. s, ridge with teeth. Ridge and teeth greatly enlarged. (After Landois.)

ducing a sharp, crackling sound which has been likened to that of burning stubble. By paying close attention the observer can soon learn to know each species by its peculiar call. Like the other families of Orthoptera, the males alone of the *Acerididæ* have musical organs, which is quite the reverse among some animals higher in the scale of life, where the females make most of the music and oftentimes much of the noise.

The great majority of Indiana *Acerididæ* pass the winter in the egg stage, the eggs being deposited by the mother insect in early

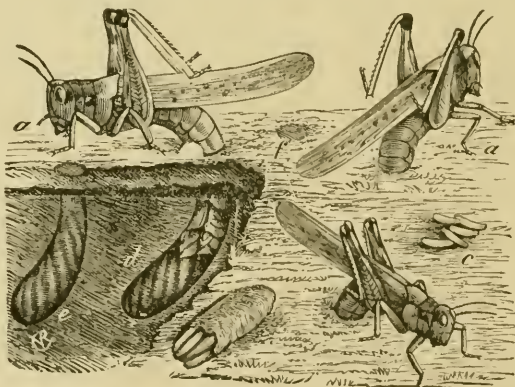


Fig. 36. Locust in the act of laying eggs. (After Riley.)

autumn. When ready to oviposit, she forms a hole in the ground or other nidus to a depth corresponding to the length of her abdomen. The eggs are then deposited one at a time to the number of 30 to 60, being placed in regular order in this hole. During the process a

glutinous fluid is emitted around them which at length hardens and binds them together, thus forming a bean-shaped mass. The hole above the mass is then closed with dirt intermixed with this fluid which, when it hardens, renders it partially impervious to water. However, if the winter is an open one with many changes of temperature, many of the eggs are apt to be destroyed. By far the larger number of eggs are deposited in the earth in the manner shown in the accompanying cut. A few species, however, oviposit in rotten or

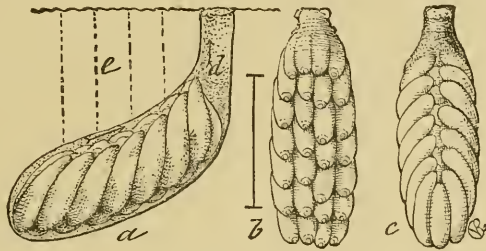


Fig. 37. Egg mass of locust. *a*, from the side, within burrow; *b*, from beneath; *c*, from above; enlarged. (After Riley.)

decaying wood. About mid-April the eggs begin to hatch and the sprightly little insects, devoid of wings but otherwise like their parents, are soon seen on every hand.

Born with one earthly desire—a voracious appetite—and with one valuable possession—a pair of strong, broad jaws, which move in and out like the blades of a pair of scissors—the little hopper soon begins to use the latter to appease the former, and for twenty-four hours a day and seven days in a week, he gnaws away at the soft, green, succulent grass which surrounds him on every side. Such a procedure can have but one result. His body soon becomes too big for its surround-



Fig. 38. Molting of a locust. *a*, nymph ready to change; *b*, the skin split along the back and the adult emerging; *c*, continues the process; *d*, the adult insect drying out; *e*, perfect adult. (After Riley.)

ings. Something must give way, and that something is his skin. He casts it aside, however, with but little reluctance, for a new one is ready to take its place, and immediately begins to satiate his appetite once more. Five successive times his skin gets too small for his body and is cast aside. Between each of these moults the wings are growing, and when the fifth skin is shed he emerges a mature and full fledged insect.

However, all locusts do not pass the winter in the egg state. Three or four species hatch in early autumn and the young in various stages can, in suitable localities, be seen jumping vigorously about on any warm sunny day in mid-winter. If their presence at such a season comes to the attention of a newspaper reporter, the press of the entire State is apt to teem with warnings of a coming "grasshopper plague," of which the youngsters are thought to be the advance guard. These hibernating young are the first to reach maturity the next spring, usually becoming full grown about the 20th of April.

A number of species of *Acrididae*, especially of those belonging to the genus *Melanoplus*, possess, in the adult stage, only rudimentary tegmina and wings, and resemble immature insects or nymphs in appearance. A close examination will show, however, that these adults have the tegmina in the proper position, while in the immature stages of these and other forms, the tegmina and wings are inverted, being twisted about so that the faces and margins are just the opposite of what they are in the perfect insect.

About 540 species of *Acrididae* are known from the United States. These are divided among four sub-families, all of which are represented in the Indiana fauna, 63 species having been taken in this State. These sub-families may be separated by the following table:

A SYNOPSIS OF THE SUB-FAMILIES OF ACRIDIDÆ KNOWN TO OCCUR IN
INDIANA.

- a. Size, very small; pronotum extending to or beyond the end of abdomen; tegmina represented by small scales or lobes on the sides of the body; claws of tarsi without a pad or cushion between them. TETTIGINÆ. p. 215
- aa. Size, larger; pronotum never extending over the abdomen; tegmina usually well developed, but sometimes abbreviated or even wanting; claws of tarsi furnished with a small cushion or pad between them.
 - b. No spine or tubercle on the prosternum between the front pair of legs.
 - c. Face or front head very oblique, usually meeting the vertex at an acute angle; the fastigium horizontal or a little

ascending; foveolæ usually present and well developed; median carina of the pronotum never raised in the form of a crest, or cut by more than one sulcus.....

TRYXALINÆ, p. 232

cc. Face or front of head nearly or quite vertical and rounded where it meets the vertex; the fastigium almost always sloping sharply downward; foveolæ generally obscure; median carina of pronotum often crested and usually cut by more than one sulcus.....

CEIDIPODINÆ, p. 251

bb. A distinct conical or cylindrical spine present on the front margin of the prosternum.....

ACRIDINÆ, p. 285

Sub-family TETTIGINÆ.

The members of this sub-family, known as the "grouse locusts," are our smallest Acridians. They are readily known from all other locusts by having the pronotum prolonged and tapering backward to such an extent that it reaches to or beyond the tip of the abdomen. The tegmina are rudimentary, being represented only by small oval lobes or scales, placed on the sides of the body and usually covering a small portion of the base of the wings. The wings are usually present and well developed, especially in their anal area, though both they and the tegmina are, in a few instances, wanting. The prosternum is prolonged in front by a half circular "chin piece" which envelops the maxillæ and other mouth parts like a muffler; no arolia or pads are present between the terminal claws of the tarsi. The males of most of the species are much narrower bodied than the females; their sub-anal plate, viewed from the side, is conical or triangular; the supra-anal plate lanceolate or triangular. The valves of the ovipositor are armed with small rounded teeth on their outer edges, and their extremities sharply diverge.

These little grouse locusts are the only members of our Indiana Acrididæ which pass the winter in the imago or mature stage. On the approach of winter they hide beneath chunks, chips, rubbish, the loose bark of logs, or beneath the bottom rails of old fences. Sometimes a warm sunny day in mid-winter tempts them forth in numbers, and on such occasions, the earth seems to swarm with them as they leap before the intruder, their hard bodies striking the dead leaves with a sound similar to that produced by falling hail. If the winter is an open one, with alternate periods of thawing and freezing, many of them doubtless perish. On the first warm days of spring they can be collected by hundreds from any grass-covered hillside having a sunny southern exposure, or from the boggy places along the margins

of lakes and streams. Hancock has written entertainingly of their habits as follows:

"The jump of the grouse locust is peculiar in that it is quick and inconspicuous and in this that it alights almost invariably on the ground. The young of the larger Orthoptera usually alight on grass or stems of plants, dodging behind them for protection. The remarkable color of these little Acridians, harmonizing in every instance with the soil, makes it sometimes difficult to locate them. This protective resemblance is carried out to perfection, the little insects living on the soil scattered with debris faded out by the hot sun, and the lights and shadows, in whatever way they play, are copied exactly. No shade, color or arrangement of markings seems impossible of simulation, and every individual is a study in color harmony.

"The grouse locusts feed upon the vegetable mold or decomposing soil sometimes mixed with algæ, or on the lichens, mosses, tender sprouting grasses, sedges, germinating seeds of plants and debris found in such situations. Particularly sought-after morsels are the various colored surface clays and the black muck, consisting of rich vegetable mold. They are ravenous eaters, as one might infer from the dietary list just mentioned, and the fecal excrement, on reaching the end of the abdominal appendages, is thrust away from the body by a rapid kick of the hind tibia.

"In the middle of May (Illinois) the first eggs are laid in the ground, the female accomplishing this act by making a shallow burrow with her ovipositor. The young larvæ, hatched from this brood, mature by fall, passing the following winter in the adult state. The broods hatched in late June and early July are often immature by the time winter arrives, and we find them hibernating in the pupa state. Thus it is that the Tettiginæ are about the earliest insects to be found in the spring, appearing as early as March. The time of incubation varies with the temperature, the early broods of *Tettix* hatching in twenty-three days, but as the days become warmer this period is shortened to sixteen days. The number of eggs of *Tettix* and *Paratettix* vary considerably, but there are more often 10, 13 or 16 in each burrow; in *Tettigidea* varying from 12 to 26.

"During the life of these little Tettigians they are more or less constantly in danger of enemies among the arachnida, insecta, and some of the vertebrata. The larva of a red mite (Trombidian) is one of the most frequent sources of annoyance. Acting as a parasite the Trombidian larva clings on the body and attaches itself out of the reach of the victim. There it remains to sap the juices of the host's

body. It is found on many species. Among insect pests, ants and bugs are sometimes deadly to them. In a wet ditch in June the writer found a number of small dark-brown ants dragging along the ground a female *Tettix ornatus* which had just been killed by them. When endeavoring to capture some *Tettix* at the same place my attention was drawn to a colony of these ants acting in a panicky state of excitement, the cause of this being that they had darted upon the insect the author was pursuing, tumbling it over and biting it savagely about the neck. The little locust finally escaped by a vigorous jump.

"According to P. R. Uhler, *Galgulus oculus*, a true bug, is a serious enemy. 'This insect may often be seen,' says Uhler, 'in the month of May walking about between the stones on the low banks of brooks and streams, where *Tettix* and *Paratettix* abound, watching an opportunity to seize one of these insects, and when the favorable moment arrives, leaping suddenly upon one of them, clasping it with tight embrace between the front femora and tibiae and then sucking out its vital juices.'"

Toads, fishes and birds also feed upon them when opportunity offers.

Nine genera, 45 species and numerous varieties of these grouse locusts are described from the United States in the latest monograph of the group.* Of these 12 species, representing five genera, have been taken in Indiana. The genera found in the State may be separated by the following table:

KEY TO GENERA OF INDIANA TETTIGINÆ.

- a. Antennæ with 12 to 14 joints; front femora more or less compressed, carinate above.
- b. Vertex of head extending beyond the front of eyes, wider than one of them; its front angulate or rounded, not truncate.
- c. Front dorsal margin of pronotum when truncate not advanced upon the head to the eyes; facial ridges not forked; front of vertex, when viewed from the side, angulate or sub-rounded.
- d. Pronotum with its median carina raised in the form of a crest and more or less arched lengthwise; the front margin produced in an angle over the back of the head. Upper notch or sinus on the hind margin of lateral lobe of pronotum shallow, about one-half as deep as the lower.....

XII. NOMOTETTIX, p. 218

*"The Tettigidae of North America," by Dr. J. L. Hancock, Chicago, 1902.

- dd.* Pronotum with its median carina low, not arched; its front not produced forward. Upper notch or sinus on hind margin of lateral lobe of pronotum nearly as deep as the lower. . . .XIII. TETTIX, p. 219
- cc.* Front dorsal margin of pronotum truncate and advanced upon the head to the eyes; facial ridges with their lower halves strongly forked; front of vertex, when viewed from the side, distinctly rounded.XIV. NEOTETTIX, p. 226
- bb.* Vertex of head not extending beyond front of eyes, usually narrower than one of them; its front usually truncate.XV. PARATETTIX, p. 227
- aa.* Antennæ with 21 or 22 joints; front femora distinctly and broadly grooved or sulcate above.XVI. TETTIGIDEA, p. 228

XII. NOMOTETTIX Morse (1894).

The members of this genus can be easily distinguished from the other Tettigians by the characters given in the key. The high arched crest of the pronotum, and (in our species) its projection forward in an angle over the back of the head, are especially notable. Between the posterior portion of the eyes and the median line of the pronotum a pair of nipple-like tubercles are usually present. The antennæ are short and filiform with 12, rarely 13, joints. The pronotum in most specimens reaches only to end of abdomen, the inner wings then being rudimentary. An occasional example of some of the species is found in which the pronotum is prolonged and the wings well developed. These, according to Morse, are examples of a reversion to the earlier long-winged type of females. The hind femora are wider and stouter proportionally than in the other genera.

Seven nominal species of *Nomotettix* have been described from the United States. Of these, but one has, as yet, been taken in Indiana.

17. *NOMOTETTIX COMPRESSUS* Morse. The Crested Grouse Locust.
Nomotettix compressus Morse, 96, III, 1895, 15; Scudd., 188, 1900, 15;
 Hanc., 69, 1902, 55, 58.
Batrachidea cristata Bl., 4, XXIII, 1891, 100 (not Harris).
Batrachidea carinata Bl., 6, XXIV, 1892, 33 (not Scudd.).

Body small, compressed, granulate; grayish or fuscous brown in color, the sides of pronotum often ornamented with one or two irregular shaped velvety black or black and white spots. Vertex nearly twice as wide as one of the eyes, a little higher than the eyes and extending in front of them, its front border sub-rounded. Pronotum strongly compressed, its front dorsal margin advanced in an angle over the head to the posterior third of the eyes. Median carina of

pronotum strongly crested and areolate; so compressed and thin in section that the punctulations of its surface appear translucent when held against the light. In the shorter and more common form the pronotum exceeds but slightly the tip of abdomen and the wings do not reach its apex; in the long form the pronotum extends 3 mm. and the wings 4 mm., beyond the tip of abdomen.

Measurements: Length of body, male, 7.5 mm., female, 8 mm.; of antennæ, 3 mm.; of pronotum, male, 7.3 mm., female, 8 mm.; of hind femora, male, 4.3 mm., female, 5 mm. Length of pronotum, long form, 10 mm.

This crested grouse locust probably occurs in most portions of Indiana, having been taken by the writer in Perry, Monroe, Vigo and Lake counties, while Dr. Hancock has found it abundant at Dune Park, Porter County. In the southern portion of the State it makes its home on the sides of dry sunny banks in pastures where the grass is scant or has been cropped short, and where the species of "Everlasting," *Antennaria* and *Anaphalis*, delight to grow. In such places it may be taken by the score in late autumn or early spring. In the northern counties it lives, says Hancock, "on dry, sandy soil, lightly covered by fragments of twigs, leaves, and various fine debris accumulated from past seasons. It frequently seeks retreat among prickly pear cactus on mossy covered ground, slightly sheltered by trees, among sand dunes. It is a curious little species, and though sometimes quite common locally, it requires the exercise of tact on hands and knees to capture the sprightly little insects. In the cool October morning they did not appear to jump far, but as the sunlight warmed the ground they became more active. Some were in the last pupa stage, but the majority were adult."

But two specimens of the long-winged form have been taken among the hundreds of short-winged ones collected in this State, a male in Vigo County and a female in Perry County. On account of the greater length of the pronotum, its median crest does not appear so prominent nor so strongly arched in the long-winged form as in the more common one. Dr. Hancock, in a recent letter, has given the varietal name *alavus* to this long-winged form.

XIII. *TETTIX* Charpentier (1841).

In this genus the median carina of the pronotum is distinct but not arched or raised in the form of a crest. The vertex is wider than one of the eyes, and its front projects beyond them. Antennæ short, stout or slender, usually composed of 14 joints. Pronotum with its

front margin truncate, or scarcely angulate, but little produced forward upon the head, reaching to end of abdomen in short-winged forms and much beyond it in long-winged forms of the same species; the upper lateral notch or sinus nearly as deep as the lower. Eleven species of the genus have been described from the United States, five of which are known to occur in Indiana. These may be distinguished by the following

KEY TO INDIANA SPECIES OF TETTIX.

- a. Median carina of pronotum more or less distinctly elevated along its entire length; dorsal surface of pronotum higher in the middle, sloping on the sides; its surface rugose or wrinkled, as well as granulated.
 - b. Body slender, the posterior portion of pronotum long drawn out; vertex viewed from above, obtusely angulate, its median carina not projecting beyond the sides. . . . 18 *granulatus*, p. 220
 - bb. Body less slender; pronotum less prolonged posteriorly; front of vertex rounded, its median carina distinctly projecting. . . .
 - c. Front half of pronotum with its median carina but little raised; middle femora of male but slightly enlarged, the expanded portion but one-third as long as broad. 19 *ornatus*, p. 222
 - cc. Front half of pronotum with its median carina compressed and more elevated, more or less arcuate; middle femora of male enlarged, their expanded portion nearly or quite one-half as long as broad. 20 *hancocki*, p. 223
- aa. Median carina of pronotum indistinct, being not at all or very little elevated; dorsal surface of pronotum flat, or nearly so, the surface granulated, rarely if at all rugose.
 - d. Body rather slender, the posterior portion of pronotum prolonged, acute; vertex distinctly depressed in front; eyes prominent; frontal costa straight and narrowly sulcate. 21 *arenosus*, p. 224
 - dd. Body more robust, the pronotum less prolonged posteriorly; vertex but little depressed in front; eyes of medium size; frontal costa, when viewed from the side, distinctly sinuate. 22 *obscurus*, p. 225

18. TETTIX GRANULATUS (Kirby).

Acrydium granulatum Kirby, 79, 1837, 251.

Tettix granulatus Scudd., 141, VII, 1862, 474; Id., 188, 1900, 16; Thos., 206, V, 1873, 182; Riley, 117, VIII, 1876, 150, Fig. 47; Id., 119, 1877, 230, Fig. 42; Id., 214, I, 1878, 256, Fig. 11; Id., 122, II, 1884, 192, Fig. 268; Lint., 82, II, 1885, 197, Fig. 59; Bol., 19, 1887, 91; Fern., 53, 1888, 46, Fig. 18; Morse, 94, VII, 1894, 154, 163, Plate 6, Figs. 3, 3a; Bl., 11, XXVI, 1894, 220; Bent., 3, VI, 1894, 309; Hanc., 67, XXIII, 1896, 237, Plate VI, Figs. 3, 3a; Plate IX, Fig. 28; Id., 68, X, 1899, 279; Id., 69, 1902, 69, Plate IV, Figs. 2, 2a; Lugg., 84, 1898, 107, Fig. 63.

Tettix morsei Hanc., 68, X, 1899, 280.

Color variable, usually wholly grayish or reddish brown, sometimes blackish, often with a whitish median band along the full length of the pronotum. Surface of pronotum and legs finely granulated; the dorsal surface of pronotum also rugose with numerous short ridges or

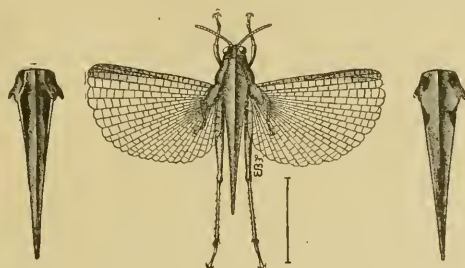


Fig. 39. *Tettix granulatus* (Kirby). (After Lugger.)

wrinkles. Anterior border of vertex considerably advanced in front of eyes, obtusely angulate or very slightly rounded, the mid-carina projecting but little if any beyond the sides. Face very oblique, eyes small. Body, especially that of male, very slender. Pronotum with front margin truncate, its posterior portion long drawn out, the apex acute, passing the hind femora; its median carina prominent throughout but not crested. Inner wings reaching to or slightly beyond tip of pronotum; in life bluish or bottle green in color. A form with the pronotum and wings more or less abbreviated is occasionally found with the common form. To it Hancock has given the varietal name *variegatus*.

Measurements: Length of body, male, 8.5 mm., female, 11 mm.; of pronotum, male, 11 mm., female, 13.5 mm.; of hind femora, male, 6 mm., female, 7 mm.

This slender grouse locust doubtless occurs throughout the State, having been taken in Lake, Porter, Fulton, Marshall, Marion and Franklin counties. It is probably much more abundant in northern than in southern Indiana, as its general range is northerly, extending from ocean to ocean and northward through British America. It has an especial liking for marshy and boggy tracts about the margins of lakes and tamarack swamps, though it is likely to occur anywhere in low wet woods. In Vigo County I found it hibernating beneath logs along the sandy border of a large river bottom pond. The light band along the middle line of pronotum is in a high degree protective when the locust dwells among the grasses and sedges of marshy tracts, as it harmonizes with the dried blades of these plants. Hancock has found *granulatus* in Wisconsin on the ground "about

prostrate tree trunks, which were molding in decay and covered with greenish lichens and moss. The yellowish and brownish fallen leaves were everywhere scattered over the bed of the forest. Occasionally, when the wind was not blowing, the author was able to mark the presence of Tettigids by the sound made as they jumped upon the dried leaves." Morse says that "in New England this species prefers sedgy meadow lands and swales on sandy soil occasionally flooded by rains or freshets and perpetually moist. The bulk of my specimens were taken on a boggy swamp which had been filled in with sand, and on which water stood more or less of the time."

19. *TETTIX ORNATUS* (Say). The Ornate Grouse Locust.

Acridium ornatum Say, 137, I, 1824, Plate V.

Acridium ornatum Say, 139, I, 1859, 10, Plate 5, Fig. 1.

Tettix ornatus Harr., 70, 1835, 577; Id., 72, 1862, 186.

Tettix ornatus Scudd., 141, VII, 1862, 474; Id., 188, 1900, 17; Glou., 62, 1872, Plate V, Figs. 1, 2; Plate XII, Fig 10; Thos., 206, V, 1873, 183; Riley, 122, II, 1884, 192; Lint., 82, II, 1885, 197; Bol., 19, 1887, 90; Fern., 53, 1888, 46; Bl., 4, XXIII, 1891, 100; Id., 11, XXVI, 1894, 220; Id., 16, 1899, 236, Fig. 62; Morse, 94, VII, 1894, 152, Plate 6, Figs. 2, 2a-c; Bent., 3, VI, 1894, 310; Hanc., 67, XXIII, 1896, plate VI, Figs. 1, 2; Plate VIII Fig. 20; Plate IX, Fig. 29; Id., 69, 1902, 78, Plate III, Fig. 4; Plate XI, Fig. 3; Lugg., 84, 1898, 108, Fig. 64.

Tettix triangularis Scudd., 141, VII, 1862, 475; Thos., 206, V, 1873, 185; Bol., 19, 1887, 91; Fern., 53, 1888, 47; Bent., 3, VI, 1894, 310; Lugg., 84, 1898, 109; Hanc., 69, 1902, 80.

Body of moderate size; color extremely variable; usually dark grayish, sometimes rusty brown or fuscous; often ornamented with two or four irregular velvety brown spots on dorsal surface of pronotum, more rarely a large whitish spot in front of these; the hind femora often with one or two white blotches on its outer face. Surface of pronotum and legs everywhere finely granulate; the posterior half of the pronotum usually rugose, with numerous short, oblique wrinkles or ridges. Vertex extending in front of eyes, somewhat rounded in front, its median carina projecting forward beyond the sides. Pronotum variable in length, in the long form less prolonged backward than in *granulatus*, its dorsal front margin truncate; the median carina distinct but not as high as in *granulatus*. Inner wings fully developed, extending a little beyond the apex of pronotum. The form with pronotum and wings shorter is, as shown by the synonymy, the one formerly known as *T. triangularis* Scudd.



Fig. 40.

Tettix ornatus
(Say). (After
Lugger.)

The two forms have been proven by Hancock to interbreed and the measurements intergrade, the following table showing the extremes:

Measurements: Length of body, male, 8.5-12.5 mm.; female, 9-13.5 mm.; of pronotum, male, 7.5-10.5 mm., female, 8-12 mm.; of hind femora, male, 4.5-5.5 mm., female, 5-7 mm.

The ornate grouse locust seems to be rather common in Indiana, having been taken in Crawford, Posey, Marion, Putnam, Lake, Porter and Laporte counties. It may be taken any month in the year but in late autumn and early spring is most abundant, being then usually found along the edges of dry open woods and on gravelly hillsides, while in summer it is occasionally found in company with *Paratettix cucullatus* about the borders of streams and ponds. It sometimes makes its home in grassy plots and lawns, especially those which are wooded, in the outskirts of cities, and is then often seen sunning on the cement and other sidewalks along their margins. The form *triangularis* more often occurs in sandy localities, and in some places far outnumbers the typical form.

On a bright sunny afternoon in late November, I once found both forms of *ornatus* very common on a sloping hillside two miles north of Indianapolis. A clover field was here adjoining an open woods pasture, and the second crop had been cut in October for the seed. Many of the dead stalks had fallen close along the fence row separating the fields, and here the Tettix were in abundance, their bodies all grayish brown, and corresponding very closely to the dead clover stems; so closely, indeed, that they were not visible until they hopped, and then had to be "marked down" before they were captured. Beneath the bottom rails of the old fence they had found a comfortable abiding place and winter retreat, and on this bright afternoon had been tempted forth to bask in the sunlight and perchance to feed upon the green clover leaves which were yet abundant in places among the dead and fallen stems.

20. *TETTIX HANCOCKI* Morse. Hancock's Grouse Locust.

Tettix hancocki Morse, 101, VII, 1899, 200; Scudd., 188, 1900, 16; Hanc., 69, 1902, 81, Plate IV, Fig. 4; Plate XI, Figs. 5, 5a.

This species is allied to *T. ornatus* Say, with which it agrees in color, granulation and rugosity of surface, but differs in its more robust form with wider and generally more projecting vertex, slightly more prominent mid-carina; in the generally more abruptly forked and wider facial costa, and notably in the enlarged middle femora; the expanded portion of the latter in the male being nearly or quite one-half as broad as long (in *ornatus* seldom more than one-third);

in the female the difference is less noticeable. The humeral angles of the pronotum are more pronounced and the mid-carina is a little more elevated in its anterior portion.

Forms with both long and short pronotum occur, the varietal name *abbreviatus* having been given to the shorter one. In the long examples the pronotum and wings pass the hind femora about 3.5 mm.

Measurements: Length of body, male, 8.3-12 mm., female, 9-13 mm.; of pronotum, male, 8.5-11 mm., female, 8-12 mm.; of hind femora, male, 5 mm., female, 5.5-6 mm.

This species has been taken only in Marion and Vigo counties. From the latter locality some of Morse's type specimens were secured. It frequents the same localities as *T. ornatus*, the species to which it is most closely allied. In the localities where it has been found, short forms have, up to the present, proven more abundant than the long ones. It will probably be found to occur more commonly in the northern half of the State, as its range is northerly, being given by Scudder as "Montreal to S. Dakota and Nebraska."

21. *TETTIX ARENOSUS* Burmeister. The Granulated Grouse Locust.

Tettix arenosa Burm., 40, II, 1838, 659.

Tettix arenosus, Bol., 19, 1887, 95; Bl., 11, XXVI, 1894, 219 (in part); Scudd., 188, 1900, 16; Hanc., 69, 1902, 68, 85, Plate III, Fig. 3; Plate IV, Figs. 5, 5b.

Tettix ornata Thom., 206, V, 1873, 184 (in part).

Body rather slender; the pronotum everywhere minutely granulate but little rugose or wrinkled. Color grayish or blackish, often with a large squarish white spot on the dorsal surface between the humeral angles; this spot usually with traces of black on its hind margin. Vertex, viewed from above, nearly twice the width of one of the eyes, depressed in front; extending but little beyond the front of the eyes, its front margin subtruncate, the median carina indistinct, scarcely if at all projecting. Eyes, when viewed from above, prominent. Antennae slender, the joints elongate. Pronotum with its front margin truncate, its posterior portion prolonged, and extending much beyond the hind femora, its dorsal surface flat, the median carina indistinct, scarcely or not at all elevated. Inner wings fully developed, a little surpassing the pronotum.

Measurements: Length of body, male, 8 mm., female, 9 mm.; of pronotum, male, 10.5 mm., female, 13 mm.; of hind femora, male, 5 mm., female, 5.5 mm.

This is a common insect in Indiana, especially in the southern half. Specimens in my collection are from Posey, Orange, Crawford, Monroe, Vigo, Putnam and Kosciusko counties. From *ornatus* it may be

readily known by its more slender form, flatter pronotum with less prominent median carina, and by its evenly and finely granulated surface. The annulations of antennæ and legs are much less distinct than in *ornatus* and the general color is not so variable. It frequents upland woods which are dry and open, being seldom found in the vicinity of water. It was originally described from South Carolina, and its general range is southern.

22. *TETTIX* *OBSCURUS* Hancock: The Obscure Grouse Locust.

Tettix obscurus Hanc., 67, XXIII, 1896, 239, Plate VII, Figs. 9, 9a, 10, 10a; Plate IX, Figs. 23, 25; Id., 69, 1902, 87; Scudd., 188, 1900, 17.

Tettix inflatus Hanc., 67, XXIII, 1896, 238; Scudd., 188, 1900, 17.

Tettix angustus Hanc., 67, XXIII, 1896, 238; Scudd., 188, 1900, 16.

Allied to *arenosus*, with which it agrees in color; body more robust. Vertex, viewed from above, twice the width of one of the eyes, but little depressed in front; extending beyond the front of eyes to a distance equal to one-fourth the diameter of one of them; its median carina but little distinct, not advanced beyond the sides. Frontal costa distinctly sinuate between the lower portions of the eyes, forming a small protuberance at the junction with the median carina of the vertex. Eyes of medium size. Pronotum truncate in front, strongly constricted before the shoulders, less prolonged backward than in *arenosus*; the median carina indistinct through most of its length, a little raised on anterior third. Inner wings extending slightly beyond tip of pronotum.

Measurements: Length of body, male, 11 mm., female, 13 mm.; of pronotum, male, 10.5 mm., female, 12 mm.; of hind femora, male, 5 mm., female, 5.5 mm.

Among a number of grouse locusts sent to Dr. Hancock were numerous examples from Vigo, Marion and Lake counties which he referred to this species. They were taken in company with *T. arenosus* and were by me considered that species. In my opinion time will show that *obscurus* is but a form of *arenosus*, as Dr. Hancock wrote me, when returning the specimens, that some of those labeled by him as *obscurus* "shade off into forms approaching *arenosus*."

Hancock's *T. gibbosus*, representatives of which he also found among the "lot of *arenosus*" I sent him from Vigo and Marion counties, I consider only a shorter and wider form of *arenosus*, having the pronotum a little more constricted than usual in front of the shoulders. The other characters given by him in his key to the species of *Tettix* are not distinctive.

XIV. NEOTETTIX Hancock (1898).

The members of this genus have the body short and thick set. Vertex wider than one of the eyes, the front margin convex or rounded; viewed from the side, a little advanced in front of the eyes. Frontal costa convex, their lower halves, viewed in front, strongly divergent or forked. Antennæ rather stout, short, composed of twelve or, rarely, thirteen segments. Pronotum with its front dorsal margin truncate, advanced over the head to the eyes, the sides of dorsal surface sloping a little downward between the shoulders; the median carina distinct, usually a little elevated between the shoulders. Hind femora enlarged, rather short. Hind tarsus with the first segment distinctly longer than the second and third together, the pad between the claws of last segment acute but more or less flat below.

Five species of this genus are known from the United States. One of these occurs in Indiana.

23. NEOTETTIX HANCOCKI sp. nov.

Body short, robust; color dark gray, the tibiæ and tarsi annulate with light and dark, the ovipositor brown. Vertex nearly twice as wide as one of the eyes; its median carina visible only on front half; its front border rounded. Frontal costa, viewed from the side, strongly convex between the bases of antennæ, the lower halves, as in other species of the genus, widely divergent. Eyes prominent, subglobose. Pronotum with its dorsal front margin truncate, reaching the eyes; the lateral carinæ on the portion in front of shoulders high and distinct; the posterior portion with the sides converging gradually to a rather sharp apex, which terminates just above the base of ovipositor; the median carina distinct throughout, more or less undulate, highest between the shoulders; the posterior lateral carina prominent throughout; the dorsal surface with a number of prominent oblong tubercles on its front half; those on posterior half shorter and more rounded; tegmina oblong, the apical half rounded. Wings abbreviated, three-fourths the length of posterior portion of pronotum.

Measurements: Length of body, female, 10 mm.; of pronotum, 8.5 mm.; of hind femora, 6 mm.

From *N. bolivari*, its nearest ally, this species is easily recognized by its more bulky form, by the more convex and prominent frontal costæ, the larger eyes, the higher lateral carinæ of pronotum behind the eyes, and especially by the prominent tubercles on the surface of the front dorsal half of pronotum. The tegmina are shorter and

broad, the upper posterior notch of lateral lobe of pronotum is deeper and the median lobule more rounded than in *bolivari*.

A single female, now in the collection of Dr. Hancock, was taken from the border of a large cypress swamp in Knox County, on July 6, 1902. It was not recognized until Dr. Hancock made a careful examination of the Indiana material of the sub-family. A second visit was made to the place on April 23, 1903, but a careful search resulted only in the finding of four half-grown nymphs. The whole swamp was covered with water several feet in depth, and the young of *hancocki* were found in company with the young and adults of other Tettigids on the higher ground bordering the water, within ten feet of its margin, and only a few rods from the nearest cypress trees. All other known members of the genus are from the southern states, and it is interesting to note that this single northern species makes its home among the isolated cypress swamps of Indiana—the cypress being a tree whose main distribution is far to the south.*

XV. PARATETTIX Bolivar (1887).

From the other grouse locusts the members of this genus may be readily known by the short and narrow vertex which does not extend beyond the eyes, its front margin being truncate. Frontal costa more or less prominent between the antennæ, declined toward their base, rarely a little sinuate. Eyes prominent, sub-globose. Antennæ of 14 segments. Pronotum with its dorsal surface flat, its front margin truncate, and, in our species, advanced forward upon the head to the eyes; its posterior portion moderately prolonged; the median earina low. Tegmina oval or elongate, punctate. Inner wings usually fully developed, rarely abbreviated. Hind tibiæ with their apical third gradually enlarged, the pads between the spurs of last joint of hind tarsi covered with numerous fine points or spicules. Five species of the genus are known from the United States, one of which occurs in Indiana.

24. *PARATETTIX CUCULLATUS* (Burmeister). The Hooded Grouse Locust.
Tettix cucullata Burm., 40, II, 1838, 658.
Tettix cucullata Scudd., 141, VII, 1862, 475; Thom., 206, V, 1873, 185.
Tettix cucullatus Bol., 19, 1887, 259, 266; Fern., 53, 1888, 47; Bl., 6, XXIV, 1892, 33; Bent., 3, VI, 1894, 309.
Paratettix cucullatus Morse, 94, VII, 1894, 163, Plate 6, Figs. 4, 4a; Hanc., 67, XXIII, 1896, 241, Plate VII, Figs. 11, 11a; Id., 69, 1902, 111, Plate VIII, Figs. 6, 7; Lugg., 84, 1898, 110, Fig. 65; Bl., 16, 1899, 236, Fig. 62; Scudd., 188, 1900, 17.

*Two additional females of *N. hancocki* were taken in the cypress swamp on July 1, 1903, by one of my assistants. The male has, however, not yet been discovered.

Color usually a uniform yellowish gray; sometimes a russet red or dull black, the tibiae annulate with light and dark. Body rather long, depressed, smoothly and evenly granulate. Vertex viewed from above, but little wider than one of the large and prominent eyes; not advanced in front of them, its front margin slightly hollowed. Pronotum truncate in front, advanced upon the head to the eyes (whence the specific name), the median carina wanting or indistinct on the front portion; low on the elongated posterior portion, which extends about 3 mm. beyond the apex of hind femora. Inner wings exceeding the pronotum by 2 mm.



Fig. 41. *Paratettix cucullatus* (Burm.).
(After Lugger.)

Measurements: Length of body, male, 9 mm., female, 12 mm.; of pronotum, male, 10.5 mm., female, 13 mm.; of hind femora, male, 5.5 mm., female, 7 mm.

The "hooded grouse locust" doubtless occurs throughout the State, having been noted in Spencer, Knox, Monroe, Vigo, Putnam, Marion and Marshall counties. It is most always found along the damp sandy or muddy banks of ponds, lakes and streams, usually in company with *Galgulus oculatus* and other semi-aquatic insects. Its modest hues agree admirably with such surroundings, thus furnishing the insect valuable protection against its foes. When disturbed it more often flies than leaps, its flight being more prolonged than any other of our Indiana Tettigians. It often alights upon the water, where it swims with ease, its dilated hind tibiae being then of much aid to its onward progress.

XVI. TETTIGIDEA Scudder (1862).

The grouse locusts belonging to this genus are more robust and clumsy in form than those we have previously treated, and possess a larger head and less oblique face. They may also be readily distinguished by their 22-jointed antennae and by the fore femora being sulcate or grooved along their upper margin. The crown of the head has a small lobe on each side which encroaches upon the upper inner border of the eye. The vertex is wider than one of the eyes and has its front border more or less rounded. Pronotum with its dorsal surface finely granulate and usually more or less rugose or wrinkled; its sides sloping downward between the shoulders, the posterior portion flat and either long drawn out or abbreviate; the anterior margin rounded, angulate or acute and more or less projected forward upon the head; the median carina distinct. As in the previous genera, the males are much more slender than the females and both the pronotum

tum and inner wings vary much in length in the same species, much confusion of synonymy having therefore resulted. Eight nominal species have been described from the United States. Of these four occur in Indiana.

KEY TO INDIANA SPECIES OF TETTIGIDEA.

- a. Front margin of the pronotum produced on the head and between the eyes nearly to their front in the form of an acute angle or sharp cusp.
 - b. Body rather stout; vertex but little projecting beyond the eyes; the pronotum broad across the shoulders, its dorsal surface strongly rugose or wrinkled, its median and lateral carinae well developed. 25 *armata*, p. 229
 - bb. Body slender; vertex more projecting, the pronotum narrow across the shoulders, its dorsal surface finely wrinkled, its carinae but slightly developed. 26 *spicata*, p. 230
- aa. Front margin of pronotum obtuse angulate or rounded, produced on the head only to front of posterior third of eyes.
 - c. Vertex of head rather strongly advanced in front of eyes, the union of its median carina and frontal costa, prominent; front margin of pronotum obtuse angulate; eyes of average size; antennae stout. 27 *parvipennis*, p. 230
 - cc. Vertex of head but little produced in front of eyes; the union of its median carina and frontal costa less prominent; front margin of pronotum broadly rounded; eyes prominent, antennae more slender. 28 *lateralis*, p. 231

25. TETTIGIDEA ARMATA Morse.

Tettigidea armata Morse, 96, III, 1875, 107; Bl., 15, XXX, 1898, 60; Scudd., 188, 1900, 18; Hanc., 69, 1902, 142, Plate X, Fig. 6.

Tettigidea armata depressa Morse, 96, III, 1895, 107; Bl., 15, XXX, 1898, 60; Hanc., 69, 1902, 142.

Color dark gray or brown above, blackish on the sides, the tegmina with a white spot on their apical third; the hind femora usually more or less mottled with whitish on their outer face. Body rather robust; vertex but little projecting beyond the front of the eyes; the frontal costa, when viewed from the side, prominent. Pronotum with its front dorsal margin projecting forward between the eyes in the form of an acute tooth or cusp; its median carina distinct, sharp, nearly horizontal, its dorsal surface distinctly roughened with rather long wrinkles, the sides in front of the shoulders a little excavated. In the long form the wings and pronotum pass the hind femora. In the short form, *T. armata depressa*, the pronotum is abbreviated and the wings more or less abortive.

Measurements: Length of body, long form, male, 11 mm., female, 15 mm.; of pronotum, male, 11.5 mm., female, 14 mm.; of hind fe-

mora, male, 6 mm., female, 7.5 mm. Short form, length of body, male, 8.5 mm., female, 11.5 mm.; of pronotum, male, 7.5 mm., female, 11.5 mm.; of hind femora, male, 5.5 mm., female, 7.5 mm.

Morse's type specimens of this species were in part secured by me in Vigo County, where it occurred in small numbers along the wooded margins of a large lowland pond. It has also been taken in Monroe County, along the margins of a lake near Waterloo, Dekalb County, and by Dr. Hancock near Dune Park, Porter County, so that it probably occurs throughout the State in low, damp, wooded localities. Outside of Indiana it has been recorded from Louisiana, Texas, Florida and Illinois. In my experience the short winged form is much less common than the long winged.

26. *TETTIGIDEA SPICATA* Morse.

Tettigidea spicata Morse, 96, III, 1895, 108; Scudd., 188, 1900, 18; Hanc., 69, 1902, 144, Plate X, Fig. 5

Body small, slender; vertex more projecting than in *armata*; the body narrower between the shoulders; the lateral carinae of pronotum but slightly developed; the median carina less distinct; the dorsal surface more finely rugulose.

Measurements: Length of body, female, 14.5 mm.; of pronotum, 14 mm.; of hind femora, 7.5 mm.

Among the specimens of this genus submitted to Dr. Hancock for examination he found a single female of this species, taken near Grand Chain, Posey County, April 26, 1901. Several additional specimens were taken along the margin of the Cypress Swamp, Knox County, April 23, 1903. *Spicata* is a form of southern range, having hitherto been recorded only from Georgia and Florida. Its presence in Posey and Knox counties is but another link in the chain of proof that the southern third of Indiana is a portion of the territory in which the sub-tropical and boreal forms of the eastern United States overlap and merge.

27. *TETTIGIDEA PARVIPPENNIS* (Harris).

Tettis parvipennis Harris 70, 1833, 583; Id., 72, 1862, 187, Fig. 82.

Tettigidea parvipennis Morse, 96, III, 1895, 108; Hanc., 67, XXIII, 1896, 242, Plate VII, Figs. 12, 12a; Id., 69, 1902, 148; Walk., 217, XXX, 1898, 124; Scudd., 188, 1900, 18.

Tettigidea parvipennis pennata Morse, 96, III, 1895, 109; Hanc., 69, 1902, 146, Plate X, Fig. 7.

Tettigidea polymorpha Scudd., 141, VII, 1862, 477; Fern., 53, 1888, 48; Bl., 4, XXIII, 1891, 100 (in part); Morse, 94, VII, 1894, 164 (nec. Burm.); and doubtless many other authors under the same name.

Tettigidea lateralis Scudd., 141, VII, 1862, 477; Fern., 53, 1888, 48; Bl., 4, XXIII, 1891, 100 (in part); Morse, 94, VII, 1894, 164, Fig. 5 (nec. Say); and other authors under the same name.

Color, grayish, light brown or fuscous above; the sides blackish, the tip of pronotum with a small white spot; the male with the lower part of face, mouth parts, and the lower sides of pronotum in front of legs, ivory white; the female with the last two joints of palpi, and often a spot on the upper outer half of hind femora, white. Body robust; vertex about twice the width of one of the eyes, projecting rather strongly in front of eyes. Frontal costa straight, the upper half, when viewed from the side, prominent; the lower half sloping gradually. Antennæ slightly flattened, the joints of the middle third not over two and a half times as long as broad. Pronotum with its front dorsal margin terminating in an obtuse angle which reaches opposite the posterior third of eyes; its dorsal surface rugose with distinct, branching vein-like wrinkles; its median carina distinct, but little elevated; its posterior portion slightly surpassing the tip of abdomen; or, in the long form, *T. parvipennis pennata*, passing the tip of hind femora. Inner wings either aborted or in the form *pennata* equaling or slightly exceeding the pronotum in length.

Measurements: Long form, length of body, male, 12.5 mm., female, 15 mm.; of pronotum, male, 10.5 mm., female, 14 mm.; of hind femora, male, 5.7 mm., female, 7.2 mm. Short form, length of body, male, 9.5 mm., female, 13 mm.; of pronotum, male, 8.5 mm., female, 12.5 mm.; of hind femora, male, 5.4 mm., female, 7 mm.

This is a very common grouse locust throughout Indiana, frequenting both dry upland woods, fence rows, and low marshy tracts. Its mating season appears to be the whole year round, as I have taken specimens in copulation in nearly every month, even on sunny days in mid-winter. It hibernates usually in small colonies or groups—as many as eleven having been found huddled together within the space of a few square inches on the under side of a log or chunk. E. M. Walker has found it hibernating in a beetle-boring in a log, the hole being completely hidden by the bark. The general color of the pronotum varies greatly in different examples, each insect seemingly seeking that local habitat which corresponds closely to its hue.

28. *TETTIGIDEA LATERALIS* (Say).

Acrydium laterale Say, 137, I, 1824, 10, Plate 5; Id., 139, I, 1859, 10, Plate 5.

Tettigidea lateralis Scudd., 141, VII, 1862, 477 (in part); Id., 188, 1900, 18; Thos., 206, V, 1873, 187 (in part); Bl., 4, XXIII, 1891, 100 (in part); Id., 16, 1899, 236, Fig. 62; Hanc., 66, XXVIII, 1894, 483, Plate XIII; Id., 69, 1902, 149, Plate X, Fig. 9; Morse, 96, III, 1895, 108; Lugg., 84, 1898, III, Fig. 66 (in part).

Color as in *T. parvipennis*; vertex less projecting in front of eyes than in that species. Frontal costa, viewed from the side, less prominent. Eyes larger. Antennæ filiform, the joints of the middle third, three to four times as long as broad. Pronotum with its front dorsal margin more or less rounded, but little produced forward upon the head; its dorsal surface rugose as in *parvipennis*; its posterior portion surpassing the tip of hind femora in the long form; reaching the end of abdomen in the short form, *T. polymorpha* Burm. (?). Development of inner wings, as in other species, depending upon the length of pronotum.



Fig. 42. *Tettigidea lateralis* (Say).
(After Lugger.)

Measurements: Length of body, male, 12 mm., female, 14.5 mm.; of pronotum, male, 9.5 mm., female, 12 mm.; hind femora, male, 5.5 mm., female, 7 mm.

This is a species of southern range which in Indiana has been taken so far only in Vigo, Putnam, Monroe, Crawford, Floyd, Knox and Posey counties—all in the southern half of the State. It frequents the same localities and has the same habits as *T. parvipennis*. Hancock has described a form as variety *medialis* to which he referred many of the specimens submitted to him from Indiana. This appears to be, in part, a connecting link between *parvipennis* and *lateralis*, and an examination of a large series of specimens from all parts of the Eastern United States will probably show that the two species are the same. In that case *lateralis* would have the priority in name.

Sub-family TRYXALINÆ.

In the members of this sub-family the vertex is horizontal or a little ascending; the face is decidedly oblique and usually meets the vertex at an acute angle; the lateral foveolæ are usually present and well developed, though in a few genera they are absent or invisible from above. The eyes are usually longer than that portion of the cheeks lying below their orbits. The antennæ are variable, being often depressed, acuminate or clavate, and inserted between the middle or below the middle of the eyes. The dorsal field of the pronotum has its front and hind margins of nearly equal width; the lateral carinæ usually distinct; the median carina cut by but one sulcus and never crested, and the surface smooth. The tegmina and wings are often short and imperfectly developed. Long and short winged forms of the same species are not uncommon. The wings are generally transparent, never bright colored or with a black band.

Our members of this sub-family for the most part frequent the borders of marshes and damp prairie meadows, making their homes among the tall rank grasses and sedges which there abound. They usually move by flying, making no noise while on the wing. One or two species, however, delight in sandy or clayey places, where clumps of bunch and wire grass furnish them protection and food. Their inner wings are never bright colored and showy as in the next sub-family, and their tegmina have remained a green or straw color in order to harmonize with their chosen abiding places. The males stridulate, or call the opposite sex to them, only when at rest by rubbing the inner surface of the hind thighs against the outer surface of the wing covers. No one of our species occurs in sufficient numbers to do much damage to vegetation, and some of them are among the least common of the Acrididæ. The winter of all is passed in the egg stage.

Thirty-eight genera and 90 species of *Tryxalinæ* are listed by Scudder from the United States, mostly from the region west of the Mississippi River, and one or two additional species have been described since his catalogue was issued. Of these, but nine species, representing eight genera, have as yet been taken in Indiana, though several others may in time be found to inhabit limited areas of the State. Our genera may be separated by the following table:

KEY TO INDIANA GENERA OF TRYXALINÆ.

- a. Foveolæ of the vertex wanting or invisible from above; face very oblique.
 - b. Sides of the fastigium strongly rounded, so that the apex is in no way acuminate; antennæ strongly flattened at the base; pronotum with the lateral lobes vertical and straight and the lateral carinæ parallel; median carina of the pronotum cut much behind the middle; tegmina fully developed, acuminate or angulate at apex.....XVII. TRYXALIS, p. 234
 - bb. Sides of the fastigium straight or gently rounded so that the apex is more or less acuminate; antennæ variable; pronotum with the lateral lobes less distinctly vertical; the lateral carinæ gently or strongly sinuate near the middle (except in *Dicromorpha*); median carina of the pronotum cut in or but little behind the middle; tegmina rounded at apex.
 - c. Hind tibia armed with 18 to 21 spines on the outer margin.....XVIII. SYRBULA, p. 236
 - cc. Hind tibia armed with not over 15 spines on outer margin.
 - d. Antennæ relatively short, at most but little longer than head and pronotum together; fastigium of vertex with no distinct median carina.

- c.* Pronotum with the sides elongate, the length on dorsal margin greater than the depth; the disk of one color; lateral carinae parallel throughoutXIX. DICROMORPHA, p. 238
- cc.* Pronotum with the sides not elongate; the disk particolored; the lateral carinae diverging both before and behind the middle.....
- XX. ORPHULELLA, p. 239
- dd.* Antennae long, about or more than half as long again as head and pronotum together; fastigium of vertex with a median carina. .XXI. CHLŒALIS, p. 243
- aa.* Foveola of the vertex always present; visible from above; face less oblique than in the preceding genera.
- f.* Tegmina without well developed elevated intercalary vein. Median carina of pronotum not high and sharp, never cut plainly in front of middle by the principal sulcus
- g.* Apical spurs on inner side of hind tibiae equal in length; lateral carinae of pronotum distinct throughout their full length; broadest part of male tegmina lying beyond the middle....XXII. STENOBOTHRUS, p. 246
- gg.* Apical spurs on inner side of hind tibiae very unequal in length, the inferior twice, or nearly twice as long as the superior; lateral carinae of pronotum distinct only on metazona; broadest part of male tegmina lying at the middle.....
- XXIII. AGENEOTETTIX, p. 248
- ff.* Tegmina with strongly developed, elevated, intercalary vein. Median carina of pronotum rather high and sharp, cut plainly in front of middle by principal sulcus.....XXIV. MECOSTETHUS, p. 249

XVII. TRYXALIS Fabricius (1775).

Vertex horizontal, semi-elliptical, projecting in front of the eyes to a distance about equal to that between the eyes; furnished with a delicate median carina. Lateral foveola wholly wanting. Face, viewed from the side, sloping strongly backward. Antennae flattened at the base, acuminate, about as long as the head and pronotum. Disk of pronotum plain, the three carinae parallel, distinct, the median cut by one sulcus much behind the middle. Lateral lobes of the pronotum perpendicular and parallel, a little longer than high, with

both the front and hind margins oblique; the former straight, the latter sinuate. Tegmina much longer than the abdomen; acuminate or angulate at apex. Hind femora slender, the apex reaching (female) or exceeding by nearly half their length (male) the abdomen. But one species belongs to the genus as at present restricted.

29. *TRYXALIS BREVICORNIS* (Linnæus). The Short-horned Locust.

Gryllus (Acrida) brevicornis L., 81, II, 1767, 692.

Truxalis brevicornis Fabr., 50, 1775, 279; Thom., 211, 1880, 97; McN., 88, VI, 1891, 66; Id., 89, VI, 1897, 211, Plate I, Fig. 5; Bl., 4., XXIII, 1891, 75; Id., 11, XXVI, 1894, 221; Id., 15, XXX, 1898, 61; Beut., 3, VI, 1894, 291, Plate VIII, Figs. 1, 2.

Tryxalis brevicornis, Burm., 40, II, 1838, 607; Morse, 98, VII, 1896, 325, 382, Plate 7, Figs. A, Aa; Scudd., 188, 1900, 19.

Pyrgomorpha brevicornis Glov., 62, 1872, Plate IV, Fig. 14; Thom., 206, V., 1873, 67.

Opsomala punctipennis Serv., 196, 1838, 590; Thom., 202, V, 1865, 447.

Pyrgomorpha punctipennis Thom., 206, V, 1873, 68.

Opomala punctipennis Thom., 206, V, 1873, 196.

The females of this species are dimorphic as regards color, being either a pale green more or less dotted with brown on the tegmina, or a uniform rusty brown. The green form has the lateral carina of pronotum, antennæ and edges of vertex brown. The males, which

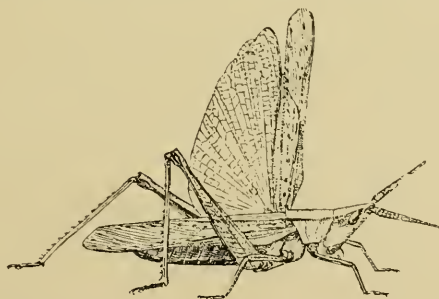


Fig. 43. *Tryxalis brevicornis* (L.) Female, natural size. (After Beutenmüller.)

are much smaller, usually have the dorsal surface, face and tibiae of fore and middle legs, bright green, the remainder of the body dark brown. Inner wings transparent, with the veins greenish. The structural characters are given above under the generic heading.

Measurements: Length of body, male, 20 mm., female, 33 mm.; of antennæ, male, 10 mm., female, 11 mm.; of pronotum, male, 4.5 mm., female, 6.5 mm.; of tegmina, male, 20 mm., female, 31 mm.; of hind femora, male, 14 mm., female, 20 mm.

This curious long headed locust occurs in suitable localities throughout Indiana, though Scudder in his catalogue gives its range as the "southern United States." It has been taken both in Steuben and Lake counties, in the extreme northeastern and northwestern corners of the State, as well as in nearly every other county where collections have been made. Walker has recently taken a few specimens near Point Pelee, Ontario. It is found only in the tall grasses and sedges along the margins of lakes, ponds, streams and swales, and in such localities is usually locally abundant. It reaches maturity in central Indiana about July 20, and in the northern part of the State a fortnight later. The hind legs are very slender as the insect seldom leaps when disturbed, but uses the wings in strong, zig-zag, noiseless flight, usually alighting on a stem of grass or sedge a dozen rods away. Frank Hay, living on the north shore of Bass Lake, Starke County, reports a flight of this species after dark on the evening of August 13, 1901. Large numbers flew onto the porch and against the house and many were captured and used for fish bait.

XVIII. SYRBULA Stal (1873).

Head nearly as long as the pronotum, the occiput moderately rounded and distinctly ascending. Vertex sub-triangular, the front margin sub-acuminate, the sides rather prominent, the median carina distinct. Lateral foveolæ very small or wanting; when present, invisible from above. Antennæ flattened at the base and acuminate in both sexes; expanded apically in the male. Pronotum with the three carinæ distinct; the lateral gently or strongly sinuate, so that the disk is plainly narrower in the middle; all the carinæ cut by one sulcus a little behind the middle. The lateral lobes of pronotum about as high as long, their front and hind margins moderately oblique, the latter a little sinuate; the lower margin more or less undulate. Tegmina and wings well developed, exceeding the abdomen in both sexes. Hind femora unusually long and slender, surpassing the tips of the tegmina in our species. Hind tibiæ armed on the outer margin with 19 to 21 rather small spines. Last ventral segment of male acutely conical. Three species are known from the United States. Of these, one occurs in Indiana.

30. SYRBULA ADMIRABILIS (Uhler). The Handsome Locust.

Stenobothrus admirabilis Uhl., 212, II, 1864, 553; Glov., 62, 1872, Plate IV, Fig. 13; Thom., 206, V, 1873, 84.

Syrbula admirabilis Thom., 211, IX, 1880, 100; Bl., 4, XXIII, 1891, 76; McN., 89, VI, 1897, 222; Scudd., 188, 1900, 19.

Syrbula leucocerca Stal., 200, I, 1873, 102.

Male much smaller and more slender than the female; its general color olive brown and yellowish. Face yellowish, the corners of the mouth pitch brown. Antennæ with basal two-thirds yellowish, the apical club-shaped portion black on one side and pale on the other. A narrow line running obliquely backward from each eye to the pronotum and the lower third of lateral lobe of pronotum, yellowish. Tegmina brownish, the disk more or less dusky near the base. Hind femora yellowish with two or three oblique dusky bars on the upper outer face, apex black; hind tibiæ pale, the spines tipped with black.

Female: Face and sides of the head green; antennæ pale at base, the apical half dusky. A pale reddish brown stripe extends from the tip of vertex backward to the hind margin of the pronotum; this bordered on each side by a black stripe which is much narrower on the head. Sides of the pronotum green with a fuscous bar across the middle. Tegmina smoky brown, the dorsal and anal fields each with a bright green stripe; the latter notched above by the serrations of a fuscous stripe, which lies between the two green areas; the wings, smoky brown, tinged with greenish yellow at the base. Hind femora with the upper lateral carina whitish; the upper outer face green, the lower, reddish brown; hind tibiæ as in male. The ground color of the female is rarely brown, and that of the male rarely green. The structural characters are given above under the genus heading.

Measurements: Length of body, male, 22 mm., female, 35 mm.; antennæ, male, 9.5 mm., female, 10 mm.; of pronotum, male, 4.5 mm., female, 6 mm.; of tegmina, male, 18 mm., female, 27 mm.; of hind femora, male, 17.5 mm., female, 24 mm.

This prettily colored locust is nowhere common in Indiana, and as yet has been taken only in the southern half of the State, in Vigo, Putnam, Marion, Monroe, Crawford, Floyd, Knox and Posey counties. It frequents, for the most part, high, open uplands, where the soil is poor and covered with scant vegetation, though it is sometimes found in timothy meadows and along roadsides where the grass has been cropped short. But few individuals have been noted in any one locality. It reaches maturity about August 1. The males differ so much in size and color from the other sex that they are very apt to be considered a distinct species. As the slender legs indicate, the movements are made mostly by the wings, the flight being rapid and noiseless. The range of *admirabilis* is given by McNeill as "United States east of the Rocky Mountains, extending as far north as Nebraska and northern Illinois, and on the Atlantic coast to Maryland."

XIX. DICROMORPHA Morse (1896).

Vertex much shorter than broad; the lateral carinæ distinct, elevated, and meeting in front in a blunt point; median carina and lateral foveolæ wholly wanting. Antennæ about the length of the head and pronotum together, the joints moderately flattened. Disk of the pronotum flat, the carinæ distinct, straight and parallel, all cut behind the middle by the principal sulcus. Lateral lobes of the pronotum perpendicular, longer than deep, the front and hind margins strongly oblique; the latter plainly sinuate; the lower margin more strongly sinuate. Tegmina usually more or less aborted, rarely reaching the end of abdomen. Hind femora stout and not banded. Two species are known from the United States, one of which occurs in Indiana.

31. DICROMORPHA VIRIDIS (Scudder). The Short-winged Green Locust.

Chlœaltis viridis Scudd., 141, VII, 1862, 455; Glov., 62, 1872, Plate VI, Fig 11; Plate X, Fig. 5; Thom., 211, IX, 1880, 92, 99; Fern., 53, 1888, 36; McN., 88, VI, 1891, 64; Beut., 3, VI, 1894, 292, Plate VII, Fig. 10.

Chrysochraon viridis Thom., 206, V, 1873, 75; Bl., 4, XXIII, 1891, 75; Id., 11, XXVI, 1894, 221.

Dicromorpha viridis Morse 98, VII, 1896, 326, 383, Plate 7, Figs. 7, 7a; McN., 89, VI, 1897, 231; Lugg., 84, 1898, 124, Fig. 71; Bl., 16, 1899, 241, Fig. 67; Scudd., 188, 1900, 25.

Chlœaltis punctulata Scudd., 141, VII, 1862, 455; Fern., 53, 1888, 36.

Chrysochraon punctulata Thom., 206, V, 1873, 76.

Opsomala brevipennis Thom., 202, V, 1865, 451.

Travalis angusticornis Stal., 200, I, 1873, 105.

Color of male dull brown, the top of head, disk of pronotum and dorsal field of tegmina usually bright green, rarely brown; face pale yellowish brown. Female, either bright green or dirty brown; often with a narrow dark line beginning behind the eye and running along the upper portion of lateral lobe of pronotum. Tegmina ovate lanceolate, about half the length of abdomen in the female, three-fourths its length in the male. Hind femora reaching tip of abdomen in the female, exceeding abdomen one-third their length in male. Very rarely the tegmina reach to or beyond the tip of abdomen; this form having been described as *punctulata*.

Measurements: Length of body, male, 16 mm., female 27; of antennæ, male and female, 8.5 mm.; of pronotum, male, 4 mm., female, 6 mm.; of tegmina, male, 8.5 mm., female, 9 mm.; of hind femora, male, 11.5 mm., female, 15 mm.

This is a common locust throughout the State, frequenting the borders of open woods, fence rows, roadsides, and especially the vicinity of the coarse grasses which grow along the margins of lakes, ponds and other wet places. There, as long as motionless, they are invisible, and there they flourish in peace and countless numbers. In southern Indiana *D. viridis* reaches maturity by July 1st, and the sexes may be found mating from then until after heavy frost. The brown female far outnumbers the green one in this State, especially during the autumn days, when their hues correspond so closely to the dead leaves which cover their haunts of the summer months. The green backed males are, however, the prevailing form of that sex at all seasons. The long winged form has not, as yet, been taken in Indiana. The wings of the other form are too short for flight, and it tries to escape when disturbed only by leaping clumsily.

When the late spring and early summer have been more than usually damp, hundreds of dead and dying specimens of this species and of *Melanoplus bivittatus* Say, are often to be seen in late July in the tops of iron weeds. They are principally females, and their death is probably due to the insect fungus, *Entomophthora calopteni* Bessey; an interesting account of which appeared in Bull. 22, U. S. Dept. Agr., 1890, 104. The disease is, perhaps, more abundant on account of the young being exposed to so much dampness in May and June. In two instances females of the lubberly locust, *Melanoplus differentialis* Thos., have been discovered feeding upon the dead bodies of *D. viridis*, the abdomen and soft portions of thorax having been wholly devoured.



Fig. 44. *Dicromorpha viridis* (Scudd.). Female, one and one-half times natural size.
(After Lugger.)

XX. ORPHULELLA Giglio-Tos. (1894).

Vertex nearly horizontal, never extending in front of the eyes a distance greater than its own width. Median carina, if present, very faint. Lateral foveola usually present on side margins of vertex, but small and not visible from above. Antennæ filiform, sometimes depressed and acuminate. Pronotum with the median carina sharp; cut in or behind the middle; the lateral carinae generally diverging both before and behind the middle, so that the center of disk is

noticeably narrower than the front and hind margins. Lateral lobes of pronotum no longer than broad, the front border decidedly oblique, and nearly straight; the hind border less oblique and more or less sinuate; the lower margin plainly angulate near the middle. Tegmina and wings well developed, a little shorter or much longer than the abdomen; the former very narrow, the intercalary vein wanting. Hind femora of medium size.

Twelve species are known from the United States, two of which have been taken in Indiana. These may be separated as follows:

KEY TO INDIANA SPECIES OF ORPHULELLA.

- a. Vertex of head rectangular in female; a little acute in the male. Foveolæ distinct, narrowly triangular. Lateral carinae of pronotum strongly incurved, the distance between them at hind margin much greater than at front margin. Prozona and metazona about equal. Tegmina passing hind femora.....30 *pelidna*, p. 240
- aa. Vertex of head blunt, rounded, obtuse in female, rectangular in male; foveolæ indistinct. Lateral carinae of pronotum less incurved, the distance between them at hind margin being but little greater than at front margin. Prozona longer than metazona. Tegmina rarely exceeding the abdomen.....31 *speciosa*, p. 242

32. ORPHULELLA PELIDNA (Burmeister). The Smaller Spotted-winged Locust.

Gomphocerus pelidnus Burm., 40, II, 1838, 650.

Stenobothrus pelidnus Thom., 206, V, 1873, 95; Morse, 98, VII, 1894, 104.

Orphula pelidna McN., 89, VI, 1897, 234, 235; Bl., 15, XXX, 1898, 54; Lugg., 84, 1898, 125, Fig. 72.

Orphulella pelidna Scudd., 185, XXXI, 1899, 179, 187; Id., 188, 1900, 24.

Stenobothrus maculipennis Scudd., 141, VII, 1852, 458; Glov., 62, 1872, Plate V, Fig. 14; Thom., 206, V, 1873, 87; Id., 211, IX, 1880, 88, 102, Figs. 12, 16; Riley, 122, II, 1884, 202, Fig. 282; Lint., 82, II, 1885, 196, Fig. 58; Fern., 53, 1888, 37, Fig. 14; Morse, 92, VI, 1893, 478, Figs. 3, 4; Beut., 3, VI, 1894, 293, Fig. 7, Plate VIII, Fig. 4.

Orphula maculipennis Morse, 98, VII, 1896, 326, 408, Plate 7, Figs. 8, 8a.

Stenobothrus propinquus Scudd., 141 VII, 1862, 461; Thom., 206, V, 1873, 90.

Vertex with the margin distinctly raised above the disk; the median carina absent; its central depression removed from the apex one-third to one-fourth the width of the vertex. Antennæ but little depressed, slightly longer than head and pronotum, the middle joints three to four times as long as wide. Median carina of pronotum cut

very near the middle by the principal sulcus. In the male the hind femora extend about 2 mm. beyond the end of the abdomen, and are slightly exceeded by the tegmina. In the female, both hind femora and tegmina are about equal, and exceed the abdomen less than in the male. Other structural characters are given in the key.

Color: Head and disk of pronotum either brown or green. A broad reddish brown or black band behind the eye reaches back to hind margin of pronotum; this limited above by the lateral carinæ of pronotum, which are whitish, but partially crossing the carinæ onto the posterior third of disk. Sides of pronotum below the band brownish. Tegmina either brown or green, with a median band of equidistant square black spots along their full length; in addition a few black spots below the median band. Abdomen reddish brown, the sides spotted with black. Hind femora brownish red, with traces of fuscous cross bars; hind tibiæ pale brown, annulate with whitish near the base.

Measurements: Length of body, male, 17 mm., female, 21 mm.; of antennæ, male and female, 7.5 mm.; of tegmina, male, 16 mm., female, 18 mm.; of hind femora, male, 10 mm., female, 12 mm.

Although this small spotted locust is said to occur in abundance in the United States east of the Rocky Mountains, I have met with it but once in Indiana during 15 years' collecting. This was July 27, 1897, when I found it in abundance about the margins of a small lake in one of the valleys among the sand dunes near Millers, Lake County.

It uses both the wings and legs in flight, and when close pressed often burrows into the fallen grass in an attempt to escape detection. Of 21 specimens taken, but three were females, and they were of the green variety. Five of the males were also partly green, the remainder being brown and fuscous. Morse states that in New England this species "begins to appear about the middle of July, being a week or two later than *speciosa*, and may be found during the remainder of the season. It is an active and alert species, leaping well and also flying freely and well, sometimes for two or three rods. It is found on the drier portions of the land adjoining salt marshes, on the more densely grassed portions of ground just inshore of the sandy beaches, and on sandy or loamy soil farther inland." It will probably be found to occur in isolated localities throughout northern Indiana.



Fig. 45. *Orphulella pelidna* (Burm.). Female, one and one-half times natural size. (After Lugger.)

33. ORPHULELLA SPECIOSA (Scudder).

Stenobothrus speciosus Scudd., 141, VII, 1862, 458; Thom., 206, V, 1873, 87.

Orphula speciosa McN., 89, VI, 1897, 235, 240, Plate 4, Fig. 17c; Lugg, 84, 1898, 126, Figs. 73, 74.

Orphulella speciosa Scudd., 185, XXXI, 1899, 178, 183; Id., 188, 1900, 24.

Stenobothrus aequalis Scudd., 141, VII, 1862, 459; Thom., 206, V, 1873, 89; Lint., 82, II, 1885, 196; Morse, 92, VI, 1893, 478, Figs. 5, 6; Beut., 3, VI, 1894, 294, Fig. 9.

Orphula aequalis Morse, 98, VII, 1896, 326, 409, Plate 7, Figs. 9, 9a; Brun., 34, 1897, 128, Fig. 28.

Stenobothrus bilineatus Scudd., 141, VII, 1862, 460; Thom., 206, V, 1873, 90.

Stenobothrus gracilis Scudd., 147, 1872, 250; Thom., 206, V, 1873, 94.

Vertex broader and blunter than in *pelidna*; the margins scarcely raised above the disk; a faint median carina on its front half; the central depression close to apex. Antennæ about as long as the head and pronotum, plainly flattened, the middle segments about twice as long as broad. Median carina of pronotum cut a little behind the middle by the principal sulcus. Tegmina reaching tip of abdomen in the female and tip of hind femora in the male; often shorter.

Color: Either green or brown, much as in *pelidna*, but the median row of spots on tegmina smaller and fewer in number, and sometimes wanting. The dark bar behind the eye is more faint than in that species, and seldom crosses onto the basal third of pronotal disk. Hind femora greenish or brownish, not banded. Hind tibiae, dull brown or yellowish, without paler ring near their base.

Measurements: Length of body, male, 14 mm., female, 18 mm.; of antennæ, male and female, 6 mm.; of tegmina, male, 12 mm., female, 13 mm.; of hind femora, male, 9 mm., female 11 mm.

This species is also known in Indiana only from Lake County, a single pair having been taken July 24, 1902, from the side of a railway a mile southeast of Hammond. It is liable to be found anywhere in the State as its range is given as "Nova Scotia to Texas." In northern Illinois McNeill found it confined to the tops and sides of hills. Morse has written of it as reaching maturity in New England the first week in July, and being "one of the most plentiful and widespread of our locusts, but owing to its small size and non-migratory habits it does not attract the attention given to the larger and consequently more destructive species. While somewhat local, it is found nearly everywhere on dry, sandy or loamy soils. It moves chiefly by leaping, but readily takes wing on occasion, flying, however, but a few feet. Active and alert in the hot sunny weather of midsummer,

it can best be secured by sweeping the net rapidly over the ground, a dozen or more specimens being the result of a few minutes' work."

XXI. CHLÆALTIS Harris (1841).

Vertex triangular, the lateral carina but little elevated; the median carina more or less distinct; the foveolæ wholly wanting. Antennæ long, those of male twice, and of female one and a half times the length of head and pronotum together; the joints of basal half strongly flattened. Pronotum with the three carinæ equally distinct, and cut much behind the middle by the principal suleus; the lateral carinæ more or less curved, especially in the female, so that the middle of disk is plainly narrowed. Lateral lobes of pronotum a little longer than high, the fore and hind margins straight and strongly and equally oblique, the lower margin with its posterior half nearly horizontal, its anterior half strongly ascending. Tegmina of female abortive (rarely fully developed), those of male well developed, the costal area being dilated and strongly reticulate. Hind femora of medium size; banded on the upper outer face. Ovipositor short, little exerted, the upper valves enlarged and strongly toothed at base. Two species represent the genus in the United States. Of these, one occurs in Indiana.

34. CHLÆALTIS CONSPERSA Harris. The Sprinkled Locust.

Locusta (Chlæaltis) conspersa Harr., 71, 1841, 149; Id., 72, 1862, 184.

Chlæaltis conspersa Smith, 198, I, 1868, 145; Glov., 62, 1872, Plate VI, Fig. 10, Plate X, Fig. 12; Scudd., 148, I, 1874, 370, Figs., 55, 56; Id., 168, XXIII, 1893, 75, Figs. 50, 51; Id., 180, VIII, 1897, 99; Id., 188, 1900, 25; Thom., 211, IX, 1880, 99; Fern., 53, 1888, 36; McN., 88, VI, 1891, 65; Id., 89, VI, 1897, 228, Plate III, Figs. 14, 14a; Bl., 11, XXVI, 1894, 222; Beut., 3, VI, 1894, 293, Plate VII, Fig. 9; Morse, 98, VII, 1896, 327, 419, Plate 7, Figs. 11, 11a; Lugg., 84, 1898, 121, Figs. 69, 70; Walk, 217, XXX, 1898, 124.

Chrysochraon conspersum Thom., 206, V, 1873, 76; Coms., 41, 1888, 102, Fig. 92; Id., 42, 1895, 111, Fig. 122; Bl., 4, XXIII, 1891, 75.

Locusta (Chlæaltis) abortiva Harr., 71, 1841, 149; Id., 72, 1862, 184.

Stenobothrus melanopleurus Scudd., 141, VII, 1862, 456. (Male.)

Color of male usually light-brown above with always a broad shining black bar covering the entire lateral lobe of pronotum; the tegmina without spots or with a few faint dusky ones; the hind tibiæ red or yellowish, the knees black. The female varies from dull clay yellow to dark brown, with the tegmina usually more or less sprinkled

with small black spots, and with only traces of the dark bar on sides of pronotum.

Tegmina of female covering half of the abdomen, those of male reaching nearly to its tip; inner wings shorter. The ovipositor is



Fig. 46. *Chlortia conspersa* Harr. Male and female. One and one-half times natural size. (After Lugger.)

of peculiar structure, being fitted for boring in wood, its upper valves being short, broad and toothed like a saw on the posterior edge, while the lower ones bear a strong hooked tooth at the tip. For other structural characters see above under the genus heading.

Measurements: Length of body, male, 20 mm., female, 24 mm.; of antennæ, male and female, 11.5 mm.; of tegmina, male, 11 mm., female, 9 mm.; of hind femora, male, 13.5 mm., female, 16 mm.

This handsome wood brown locust occurs throughout Indiana, but nowhere in numbers. It makes its home in thickets, in the borders of open woods, in grassy plots alongside old rail fences, and oftentimes along the borders of streams in woodland pastures, but is seldom seen in damp localities. In such places its hues correspond so closely with those of the dead leaves, fallen grass stems and other surroundings that it is seldom the insect is noted until it leaps clumsily to one side. Mature males have been taken in Vigo County on June 19th, an early date for locusts which have hatched from the egg in spring. A single female with tegmina reaching slightly beyond tip of abdomen is in my collection from Vigo County. The ordinary short winged female is apt to be confused with the brown females of *Dicromorpha viridis*, but can be readily distinguished by the presence of the median earina of vertex, and the curved lateral carinae of pronotum.

Interesting accounts of the egg-laying habits of the female of *conspersa* have been given by both Smith and Scudder. I have, on a number of occasions, noted the females with the abdomen inserted in soft or decaying wood, and on August 11, 1893, I discovered a female in the act of boring a hole in the upper edge of the topmost board of a six-plank fence. The abdomen was curved downward, and the toothed forcipate valves of the ovipositor used as pinchers with which small pieces of the wood were broken off. When dis-

covered, the abdomen was inserted nearly one-half an inch in the pine board, and the upper edge of the opening about the sides of the abdomen was covered with small pieces of wood, just as the dust or borings will accumulate about the edge of a hole which a carpenter is boring.

I stood by and watched her work for ten or more minutes, when she suddenly stopped, withdrew her ovipositor and hopped away. Along the fence, within a distance of 30 feet, I found 15 other holes, 11 of which were fresh, while the others had evidently been bored the previous year. Most of these holes were on the upper edge of the top board, which was in all cases of pine and perfectly sound. None of the holes contained eggs, most of them being less than half an inch in depth.

On July 21st, and September 21st, I have found them with the abdomen inserted full length in stumps or logs, and when removed, eggs were found in the lower horizontal portion of each cavity. On the former date the female was ovipositing after dark in an oak log which served as part of a bridge across a stream. Smith has suggested that the reason for so few holes being finished is, that the wood proves too hard, and the insect tries for a softer place, or, many of them may be disturbed during the process of oviposition. Scudder says that "the wood must be firm enough to retain the eggs well in place, and soft enough to absorb much moisture in the spring. Upright pieces of timber are never chosen, but rather short sticks of decaying, charred or pithy wood, which can not easily be broken or blown against the rocks. Holes are frequently made three-quarters of an inch deep, and abandoned because the spot proves unsuitable. In a stick about a foot and a half long, and two or three inches wide, I counted 75 borings, only three or four of which had been used as nests. The number of imperfect to perfect holes must be as 25 to one. When a good piece of wood is discovered, the nests are crowded thickly together; and a stick less than two inches in diameter and five inches in length contained 13 completed nests. The holes are pierced at a slight angle to the perpendicular, away from the insect; they are straight for about a quarter of an inch, then turn abruptly and run horizontally along the grain for about an inch. The eggs (from 10 to 14 in number) are almost always laid in the horizontal portion of the nest; they are cylindrical, tapering toward the ends, but not at all pointed, and measure from five to five and a half millimeters in length, by one and one-eighth in breadth; the ends are equally and regularly rounded. They vary in tint, some being almost colorless, and others of a faint yellow. After the eggs have been carefully packed away in the sawdust made by the abrasion of

the sides of the hole, they are covered above with a whitish froth, and the hole is sealed up just below the surface of the wood with a black glutinous secretion, excessively hard, smooth and shiny, and the upper surface slightly concave. In the spring the moisture doubtless softens these coverings so that the young grasshoppers can easily escape. Many old nests may be found uncovered and filled with the shells of the eggs, but none in which the cover is still retained."

XXII. STENOBOTHRUS Fischer (1843).

Vertex triangular, obtuse in female, acute in male; the foveolæ visible from above, as narrow, oblong, or linear impressions; the median carina absent, or at most a colored line. Antennæ filiform; much longer than head and pronotum in the male. Pronotum with the median carina distinct, cut a little behind the middle by the principal sulcus; the lateral carinæ sinuate or curved, so that the middle of disk is narrower than the fore and hind margins. Lateral lobes of pronotum about as long as deep, the front margin straight, the hind and lower margins sinuate. Tegmina variable in length, usually fully developed in male. Wings a little shorter than tegmina. Hind femora rather slender; not transversely barred. Valves of ovipositor short, but plainly exerted.

This European genus formerly included a number of United States species, Thomas having described no less than 16 species (a number of them synonymous) under it in his *Acerididæ* of North America. As at present limited, but two are listed from the United States, one of which occurs in Indiana.

35. STENOBOTHRUS CURTIPENNIS (Harris). The Short-winged Brown Locust.

Locusta (Chalcaltis) curtipennis Harr., 71, 1841, 49; Id., 72, 1862, 184, Plate III, Fig. 1; Rathv. 109, 1862, 386, Fig. 28.

Stenobothrus curtipennis Scudd., 141, VII, 1862, 456; Id., 142, II, 1868, 118; Id., 148, I, 1874, 372, Fig. 57; Id., 168, XXIII, 1893, 76, Fig. 52; Id., 180, VIII, 1897, 99; Id., 186, XXXV, 1899, 50; Id., 188, 1900, 26; Smith, 198, I, 1868, 147; Glov., 62, 1872, Plate VI, Fig. 15; Plate VII, Fig. 10; Plate X, Fig. 4; Plate XII, Fig. 18; Thom., 206, V, 1873, 91 (in part), Id., 211, IX, 1880, 104; Riley, 122, II, 1884, 202; Lint., 82, II, 1885, 196; Comst., 41, 1888, 102; Fern., 53, 1888, 37; McN., 88, VI, 1891, 65; Id., 89, VI, 1897, 260; Beut., 3, VI, 1894, 294; Morse, 98, VII, 1896, 327, 420 Plate 7, Fig. 12; Lugg., 84, 1898, 128, Figs. 75, 76.

Chalcaltis curtipennis Bl., 4, XXIII, 1891, 76; Id., 11, XXVI, 1894, 222.

Stenobothrus longipennis Scudd., 141, VII, 1862, 457; Glov., 62, 1872, Plate V, Fig. 15.

Color exceedingly variable, but in Indiana specimens usually a light brown above, with a black bar extending back from the eye along the upper half of the lateral lobe of pronotum; beneath yellowish, the sides of abdomen spotted with black and the hind knees of the same color. Sometimes the face and lower sides of pronotum are gray, or even green. Antennæ brownish yellow at base, the apical halves brown or black.

The tegmina of *curtipennis* are, in most females, about three-fourths the length of the abdomen, while in the males they usually reach to the tip of the abdomen; though they may be longer or shorter in either sex. The males are apt to be mistaken for those of *Chlocallis conspersa*, but may be distinguished by the presence of the foveolæ, by the narrower black bar on sides of pronotum and by the smaller and more slender body.

Measurements: Length of body, male, 14.5 mm., female, 21 mm.; of antennæ, male, 9.5 mm., female, 7.5 mm.; of tegmina, male, 11 mm., female, 10 mm.; of hind femora, male, 11 mm., female, 13 mm.

This is a very common locust throughout northern Indiana, but as yet has not been taken south of Putnam and Vigo counties. It abides in low, wet prairies, swales, damp meadows, and especially in the vicinity of tamarack swamps. These conditions of local habitat are common in the northern half of the State, but scarce or wanting in the southern half, except in the extensive lowlands along the Wabash River in Knox and Gibson counties, but there the locust seems to be wanting. In Putnam County it occurs in blue-grass pastures along the banks of streams in open woodland. It begins to reach maturity about June 20th. By July 1st, it has become fairly common, and it may be taken until mid-October or even later, if the frosts are not too severe. The males seem everywhere less abundant than the females. The former is an active and noiseless flier, but the female, being usually shorter winged, endeavors to escape by leaping and tumbling, and, says McNeill, "its astonishing facility as a tumbler and contortionist generally discourages all but the most determined efforts for its capture." Scudder has given a description of the song habits of *curtipennis* as follows: "When about to stridulate, these insects place themselves in a nearly horizontal position, with the head a little elevated; they then raise both hind legs together, the hind tibiæ bent back snugly against the femora during the movement, and grate the thighs against the outer surface of the tegmina. The first one or two movements are frequently noiseless or faint. In sunny weather the notes are produced at the rate of about six a second, are continued from one and a half to two and a half seconds,

and when undisturbed are repeated with intermissions of from five to six seconds. When the sky is overcast the movements are less rapid."

XXIII. AGENEOTETTIX McNeill (1897).

Vertex, somewhat declivent, the sides sharp and meeting in front almost at a right angle; the median carina wanting; lateral foveolæ rectangular or four sided, about twice as long as broad, very distinct. Face moderately oblique. Antennæ filiform, longer than head and pronotum together. Pronotum with the median carina distinct, cut once behind the middle by the principal sulcus; the lateral carinæ indistinct; strongly sinuate or curved inward; the hind margin of disk broadly rounded. Lateral lobes of pronotum higher than long, their front and hind margins nearly straight and vertical, the lower margin with its front half inclined strongly upward. Tegmina and wings well developed, equaling the abdomen in the female, usually slightly surpassing its tip in the male. Hind femora rather stout, surpassing the tip of abdomen in the male, equaling it in the female. Hind tibiæ with the spurs on the inner side at apex, much elongated and very unequal. Valves of ovipositor but little exerted, the tip only being visible. Two species are known from the United States, one of which has been taken in Indiana.

36. AGENEOTETTIX SCUDDERI (Bruner).

Aulocara scudderi Brun., 24, XII, 1890, 63; Bl., 11, XXVI, 1894, 217.

Eremnus scudderi McN., 89, VI, 1897, 268; Lugg., 84, 1898, 132, Fig.

77.

Ageneotettix scudderi Scudd., 188, 1900, 28.

Philobostroma parva McN., 88, VI, 1891, 64.

General color, dull brown, the tegmina with numerous small darker brown, quadrate spots, sometimes almost confined to a median band.



Fig. 47. *Ageneotettix scudderi* (Bruner). Male. (After Lugg.)

In most specimens a dull yellowish band reaches from the vertex backward across the middle of occiput and pronotum to the tips of the tegmina. An indistinct blackish bar extends from eye back across the upper half of lateral lobes of pronotum; and a triangular spot of

black on each side of basal third of pronotal disk, plainest in the male. Hind femora dull reddish brown with three blackish cross-bars on the upper outer face. Hind tibiæ bright coral red, with a whitish basal ring; the knees deep black. Antennæ dull reddish, sometimes lighter. Lower surface, dirty yellowish white.

Measurements: Length of body, male, 15 mm., female, 20 mm.; of antennæ, male 10 mm., female, 7.5 mm.; of tegmina, male, 9 mm., female, 13 mm.; of hind femora, male, 10.5 mm., female, 11.5 mm.

This small dull colored locust has been taken in Indiana only from the sandy bed of the old Wabash and Erie Canal, five miles north of Terre Haute, Vigo County. Here it was first taken on July 6, 1892, and afterward in September and October, 1893. On one side of the canal, at the point mentioned, is a large pond, occupying perhaps 50 acres of the Wabash River bottoms, and on the other side is a sandy hill or bluff of the river, which is covered with typical prairie grasses and plants. The locust has been found only in an area of about five acres, on the side of the hill, and in the bed of the canal. When disturbed it leaps vigorously, and without noise, for several times in succession; then settling down on a sandy spot, it will allow a close approach, evidently relying upon the similarity of color between its body and the sand to shield it from observation. According to Bruner, *loc. cit.*, it is a very common species west of the Mississippi; but east of that stream has been taken only at Moline and Cordova, Illinois; and in Vigo County, this State. It will probably be found to occur over the sand-covered portions of southwestern Indiana.

XXIV. MECOSTETHUS Fieber (1853).

Vertex horizontal; the lateral carinæ distinct, straight, the apex truncate or slightly rounded; median carina distinct; lateral foveolæ small, shallow, triangular. Antennæ filiform, longer in the male than the head and pronotum together. Pronotum with all the carinæ distinct, the median rather sharp, and cut in front of the middle by the principal sulcus; the lateral (in our species) with their posterior halves distinctly divergent; the disk rugose, the metazona longer than the prozona; the hind margin of the former obtusely angled. Lateral lobes of pronotum about as high as long, their front margins perpendicular, the hind ones a little oblique, the lower margin with its front half oblique. Tegmina and wings well developed, surpassing the abdomen in both sexes, the discoidal area furnished with a very prominent intercalary vein, which in the male is provided with a rasp for stridulating. Hind femora, rather long and slender, exceeding the abdomen in the male. The sub-anal plate of male is acutely produced, being at least twice as long as its greatest depth. Valves of ovipositor strongly exerted, the upper pair, with minute teeth along their upper margins.

Three species are known from the United States, one of which occurs in Indiana.

37. *MECOSTETHUS LINEATUS* (Scudder).

Areyptera lineata Scudd., 141, VII, 1862, 462; Id., 142, II, 1868, 118 (song of); Id., 143, XI, 1868, 313 (note of, set to music); Smith, 119, 1872, 381; McN., 88, VI, 1891, 66.

Stethocophyma lineata Thom., 206, V, 1873, 98; Id., 211, 1880, 104; Glov., 62, 1874, Plate XVIII, Fig. 9; Fern., 53, 1888, 38.

Mecostethus lineatus Morse, 98, VII, 1896, 327, 444, Figs. 13-13b; McN., 89, 1897, 254, Figs. 22a, 22b; Bl., 15, XXX, 1898, 55; Scudd., 188, 1900, 29.

General color, dark brown. A narrow yellowish line extends from the upper border of the eye to the pronotum, bordered below by an indistinct dark band which extends along the upper half of lateral

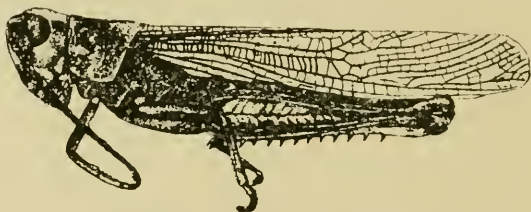


Fig. 48. *Mecostethus lineatus* (Scudd.). (After McNeill.)

lobes of the pronotum. The tegmina with a distinct pale or yellowish streak two-thirds their length, along the scapular area. Hind femora with the outer face yellowish or reddish brown, darker above, the lower face either yellowish or bright coral red, the knees black. Hind tibiae yellowish, annulate with paler near their base, the spines black. The females usually much darker than the males with the yellow line on head and tegmina often obscure. The structural characters are given above under the genus heading.

Measurements: Length of body, male, 26 mm., female, 35 mm.; of antennae, male, 11.5 mm., female, 10.5 mm.; of tegmina, male, 25 mm., female, 30 mm.; of hind femora, male, 17 mm., female, 20 mm.

This large and handsome locust occurs in isolated areas in the northern third of the State, having been taken in Fulton, Lake, Starke, Marshall, Kosciusko and Steuben counties. It is found only in low boggy meadows bordering lakes or tamarack swamps. The males seem to far outnumber the females, and are much more wild and active, taking to flight when a person is a dozen yards distant. They use the wings only in escaping, flying swiftly and noiselessly for 50 to 100 feet and alighting on the stems of the tall grasses and

sedges among which they have their homes. The only way in which I have been able to effect their capture was by running after them and swooping them with the net as they arose or before they had time to arrange their legs for the upward impetus at the beginning of a new flight. The females are more bulky and lubberly than the males, and are usually seen in more open places, where the grass is shorter, and hence are more easily taken. The earliest date at which mature specimens have been seen was July 13th, in Fulton County, and the latest, October 25th, near Bass Lake, Starke County, though they may occur both before and after these dates. In the United States *lineatus* has been recorded only from Maine, Massachusetts, Connecticut, northern Illinois and eastern Nebraska.

Sub-family (EDIPODINÆ.

This sub-family includes those genera of Indiana locusts which have the prosternum unarmed with tubercle or spine, the face nearly vertical, instead of oblique, and the head rounded at the point of union with the vertex and face. The fastigium or front of vertex slopes sharply downward; the foveolæ are present but are usually small and shallow. The antennæ are linear or sub-linear and are usually inserted above the middle of the eyes, sometimes almost above the eyes themselves. The eyes are shorter than in the sub-family *Tryxalinæ*, being rarely longer than that portion of the cheeks below their orbits. The dorsal field of the pronotum has its hind margin much wider than the front margin; the lateral carinæ usually wanting; the median carina (except in the genus *Arphia*) cut by one or two sulci, and often raised in a sharp ridge or crest, and the surface generally wrinkled or covered with small tubercles. The tegmina and wings are always fully developed and the latter, in most species, are brightly colored. All of our genera belong to the division or tribe *Edipodini* of Saussure, in which the ocelli are placed near the eyes and in which the outer margin of hind tibiæ lacks an apical spine next the spurs.

Our members of this sub-family are, when at rest with the tegmina closed, dull brown or grayish in color, and hence dwell, for the most part on bare clayey slopes, or stretches of sand; along roadsides and railways, or in closely cropped timothy meadows. Twelve of our 16 species have the inner wings black, yellow or red and hence are very conspicuous objects when in flight, being often taken for butterflies by persons who have given little attention to nature. These bright colors, are, says Morse, "in no sense protective and bear no

relation to the environment of the insects, but are probably of value in the mating of the sexes." The color of the inner wings often varies much in the same species, shading from dull white, through yellow and orange to vermilion red. The greater intensity of color is in part due to age, and perhaps in part to higher temperature, though other factors doubtless enter into its cause.

The members of this sub-family are peculiar in that the males of most of them and the females of a few stridulate while on the wing; a rather harsh, crackling or rattling note being produced by rubbing the under surface of the tegmina against certain veins on the upper surface of the inner wings. The sound seems to be under control of the insect, for they often make it when suddenly alarmed, or cease making it if too greatly frightened. Some of them produce a uniform rattling note during the entire period of flight, which is generally in a straight course. Others make the call only during certain intervals of flight. These change the direction of flight at will, and at every turn emit two or three short, rattling sounds. A number of species also sound a different call when at rest, in the same manner as do the *Tryxalinae*, by rubbing the hind femora against the intercalary vein of the tegmina, which is toothed or roughened to aid as a sounding organ.

This sub-family is also notable among our Indiana Acrididæ by having three or four species which pass the winter as nymphs or half grown young. These nymphs reach maturity about mid-April and are the first Acridians of large size to be seen in the spring. The majority of our species, however, pass the winter, as do most other locusts, in the egg stage.

Twenty-six genera and 154 species were listed by Scudder in his "Catalogue," and about 40 species have since been described. Of these, ten genera and sixteen species have been taken in Indiana. These genera may be separated by the following table in which, however, I have made use of many characters not of generic importance, in order that the beginner may the more readily determine the specimens in hand.

KEY TO GENERA OF INDIANA CEDIPODINÆ.

- a.* Median carina of pronotum raised in a distinct crest, which is entire, or not cut by the principal sulcus; tegmina sub-coriaceous, or leathery, in texture, densely and irregularly reticulate; inner wings brightly colored, red or yellow at base.XXV. ARPHIA, p. 254
- aa.* Median carina of pronotum less prominent and in female always cut by one or more sulci; tegmina with the apical half membranaceous and regularly reticulate.

- b.* Median carina of pronotum cut by but one sulcus.
- c.* Disk of inner wings pellucid or transparent, not distinctly bounded by a blackish border.
- d.* Pronotum with its disk roof shaped, the sides sloping downward; its dorsal front margin plainly angulate. Hind femora without dark cross bars.....
XXVI. CHORTOPHAGA, p. 257
- dd.* Pronotum with its disk flat; its dorsal front margin truncate. Hind femora with dusky cross bars on their outer face.
- c.* Frontal costa of male strongly sulcate throughout their full length; median carina of pronotum distinct, higher on prozona than on metazona, distinctly cut by the principal sulcus.....XXVII. ENCOPTOLOPHUS, p. 260
- ee.* Frontal costa of male but slightly sulcate just below the ocellus; median carina of pronotum low, of equal height throughout, faintly cut by principal sulcus....XXVIII. CAMULA, p. 261
- cc.* Disk of inner wings opaque, red, orange, black or yellow in color; when not black, distinctly bounded with a blackish border.
- f.* Body, especially that of female, robust. Pronotum with the lateral carinae extending in front of the principal sulcus and not cut by that sulcus; its disk often with numerous tubercles; inner wings red or yellow; tegmina usually with a number of large dark colored spots.....
XXIX. HIPPISCUS, p. 263
- ff.* Body more slender, often compressed. Pronotum with the lateral carinae extending only to the principal sulcus and cut by it; its disk with but few if any tubercles; inner wings black or pale yellow; tegmina with numerous small dark spots which are sometimes united into cross bars.
- g.* Inner wings black with a yellow border.....XXX. DISSOSTEIRA, p. 272
- gg.* Inner wings yellow, with a fuscous curved median band.....
XXXI. SPHARAGEMON, p. 275
- bb.* Median carina of pronotum cut by two sulci, the front notch often less distinct than the hind one.....
- h.* Antennae of male shorter than hind femora, the basal joints not strongly flattened. Frontal costa at all points above the ocellus, wider than the basal joints of antennae.

- i. Lower margin of lateral lobe of pronotum straight, its front half not curved upward. Median carina of pronotum about as high on metazona as on prozona; its hind notch but little in front of the middle of pronotum. . . . XXXII. MESTOBREGMA, p. 279
- ii. Lower margin of lateral lobe of pronotum with its front half curved upward. Median carina of pronotum very faint on metazona; its hind notch much in front of the middle, the metazona at least one and a half times as long as the prozona.
XXXIII. TRIMEROTROPIS, p. 280
- hh. Antennæ of male longer than hind femora, the basal joints strongly flattened. Frontal costa at its widest point above the ocellus narrower, and at the vertex much narrower, than the basal joints of antennæ.
XXXIV. PSINIDIA, p. 283

XXV. ARPHIA Stal (1873).

Vertex horizontal, either sub-pentagonal or triangular, its disk with a distinct, usually deep, transverse curved impression a little behind the middle; lateral carinæ distinct; the median carina present, but terminating at the impression; the foveolæ present, rather large, but shallow and more or less rhomboidal. Frontal costa rather broad, strongly sulcate in the region of and below the ocellus. Antennæ about as long as head and pronotum together. Pronotum with its front margin bluntly angulate, produced forward upon the posterior third of occiput; the median carina compressed, and higher than usual, not notched by the transverse sulcus; the lateral carinæ rounded, distinct only on the metazona. Lateral lobe of pronotum deeper than long, the front margin a little sinuate, the hind margin more or less oblique, the lower margin with its front half curved upward, the posterior angle rather broadly rounded. Tegmina somewhat leathery in texture, densely and irregularly reticulate, the apical third only with the cells, or spaces between the venules, distinct; the intercalary vein closer to the median than to the ulnar vein. Inner wings brightly colored, yellow or red at base. Hind femora stout, their basal halves depressed and dilated. Ovipositor with its valves moderately exerted; the upper ones with their apical halves a little inturned and narrowly spoon-shaped.

Sixteen species are accredited by Scudder to the United States. Of these but two have, as yet, been taken in Indiana. These may be separated by the following:

KEY TO INDIANA SPECIES OF ARPHIA.

- a. Upper third of frontal costa with the sides converging, meeting at the point of union with the front of vertex; median carina of pronotum lower and less curved; hind margin of pronotum ending in a right angle, or obtuse angle.....38 *sulphurea*, p. 255
- aa. Upper third of frontal costa with the sides scarcely converging; distinct at the point of meeting with the front of vertex; median carina of pronotum, viewed from the side, high and arched, crest-like; hind margin of pronotum ending in an acute angle.....
39 *xanthoptera*, p. 256

38. ARPHIA SULPHUREA (Fabricius). The Sulphur-winged Locust.

Gryllus sulphureus Fab., 51, I, 1781, 369.

Locusta sulphurea Harr., 70, 1833, 583; Id., 72, 1862, 177, Plate I, Fig. 6; Emm., 49, V, 1854, 146; Rathv., 109, 1862, 386, Fig. 27.

Cedipoda sulphurea Burm., 40, II, 1838, 643; Scudd., 141, VII, 1862, 470; Glov., 62, 1872, Plate V, Fig. 6.

Tomonotus sulphureus Thom., 206, V, 1873, 105; Id., 211, IX, 1880, 89, 107.

Arphia sulphurea Stal., 200, I, 1873, 119; Sauss., 134, 1884, 71; Fern., 53, 1888, 39; Bl., 4, XXIII, 1891, 77; Beut., 3, VI, 1894, 296, Plate VIII, Fig. 10; Morse, 99, VIII, 1897, 36, 51, Plate 2, Fig. 17; Lugg., 84, 1898, 136, Figs. 78, 79; Scudd., 188, 1900, 30.

Color, varying from dark brown, almost blackish in some males, to pale yellowish brown. The tegmina of males often with a pale yellowish band along the dorsal or hind margin; those of the lighter colored females often thickly sprinkled with small fuscous spots. Inner wings with their basal two-thirds a bright sulphur yellow. A dusky curved band covers the outer third; from which a distinct dark ray runs nearly to the base of the wing, near the front or costal margin. Hind femora with the outer face either uniform dark brown with a pale ring near the knee, or with alternating bands of black and white, which are more plainly visible on the inner face. Hind tibiae dusky black, or blue black, with a pale ring near the base. Abdomen reddish brown or yellowish. Many of the young and a few of the adults which appear in spring, or those which live on high, rocky woodland slopes where lichens are abundant, often have the pronotum and hind femora prettily marked or spotted with grayish and greenish in imitation of those lowly plants.

Measurements: Length of body, male 22 mm., female 32 mm.; of antennæ, male and female, 7 mm.; of tegmina, male 23 mm., female 26 mm.; of hind femora, male 14.5 mm.; female, 18 mm.

The yellow winged locust is a common insect throughout Indiana, making its home in dry upland pastures and meadows, along roadsides and on gravelly and rocky slopes. It passes the winter in the nymph stage sheltered beneath logs, chunks and rubbish and begins to reach maturity in central Indiana about May 1st (May 3d being the earliest date it has come to my notice), being preceded only by *Chortophaga viridifasciata*. It is most abundant in June, and about July 15th begins to be replaced by its congener, *A. xanthoptera*. However, examples have been taken in Marion County as late as September 10th. The male, when disturbed, moves in short, jerky flights, sounding its cymbals while in the air, at every turn. The sound is a sharp crackling note, and is seemingly under the control of the insect.

39. *ARPHIA XANTHOPTERA* (Germar.)

(*Edipoda xanthoptera* Germ., 58, II, 1838, 643; Scudd., 141, VII, 1862, 469; Smith, 199, 1872, 372, 381, Fig. 10.

Tomonotus xanthopterus Thom., 206, V, 1873, 105.

Tomonotus sulphureus xanthopterus Thom., 211, IX, 1880, 107.

Arphia xanthoptera Sauss., 134, 1884, 67; Fern., 53, 1888, 39; Bl., 4, XXIII, 1891, 77; Beut., 3, VI, 1894, 297, Plate VIII, Fig. 11; Morse, 99, VIII, 1897, 36, 50, Plate 2, Figs. 16, 16a; Lugg., 84, 1898, 138, Fig. 80; Scudd., 188, 1900, 31.

Arphia xanthoptera carinata Bl., 4, XXIII, 1891, 78 (not *A. carinata* Scudd.)

Color varying from a very dark to a bright reddish brown, the head and pronotum usually lighter than the tegmina; the latter in the female often sprinkled with numerous darker brown spots. Inner wings with the basal two-thirds either deep yellow or orange red, the



Fig. 49. *Arphia xanthoptera* (Germar). Male. Natural Size.
(After Beutenmüller).

outer third with the curved fuscous bar as in *sulphurea*, but the dark ray near costal margin not much longer than the width of the fuscous band, and always extending less than one-half the distance to base of wing. Hind femora dull grayish brown, the upper outer face with

two or three oblique blackish bars; a pale ring near the knee. Hind tibiae dusky, the spines black.

This species differs from *sulphurea* by having the disk of the vertex truncate in front, its lateral carinae not meeting, but continuous with the frontal costa; the latter with the sides not converging to an acuminate apex. The median carina of pronotum is higher and more distinctly arched and the posterior margin of pronotum is more acute. It is usually larger than *sulphurea*.

Measurements: Length of body, male 27 mm., female 34 mm.; of antennae, male and female, 10.5; of tegmina, male, 26 mm., female, 30 mm.; of hind femora, male, 18 mm., female, 19 mm.

This is also a common locust throughout Indiana, beginning to reach maturity in the central part of the State, from eggs hatched in the spring, about July 20th, and existing until November 1st, or later. It frequents the stubble of wheat, clover and timothy fields, the banks along railways and the borders of high, dry, open woodlands and roadsides. One-third or more of the males have the inner wings a deep orange yellow, but not more than one-sixth of the females have the wings so colored. The orange winged males are usually darker in color, and their stridulation is seemingly louder and more prolonged than in the yellow winged forms. The sound is made as the insect rises from the ground, and at times at the points of turning in its zigzag flight. *Xanthoptera* is a stronger and more active flier than *sulphurea* and its note is louder and readily distinguished from that of the latter.

XXVI. CHORTOPHAGA Saussure (1884).

Body rather slim, compressed, punctate or fine wrinkled, green or brown in color. Vertex horizontal, triangular; the apex truncate; the lateral carinae not prominent, the median carina wanting; the foveolae very shallow, elongate, triangular. Frontal costa prominent, rather narrow, punctate, sulcate below the ocellus, the margins of upper fourth slightly converging to meet those of the vertex. Antennae no longer than head and pronotum together, the joints short and somewhat flattened. Pronotum with its disk roof shaped, its front margin bluntly angulate, projected slightly forward on the occiput, the hind margin acute angled; the median carina not prominent, straight and but faintly notched a little before the middle by the principal sulcus; the lateral carinae visible only on the metazona, rounded and indistinct in the female, plainly visible in the male. Lateral lobes of the pronotum as in *Arphia*, the posterior angle less

rounded. Tegmina narrow, extending beyond the abdomen; the apical half membranaceous, the intercalary vein running midway between the median and ulnar veins. Inner wings pellucid, the veins but slightly swollen. Hind femora of medium size, surpassing the abdomen in the male, a little shorter in the female. Ovipositor as in *Arphia*.

Two species of the genus occur in the United States, one of which inhabits Indiana.

40. *CHORTOPHAGA VIRIDIFASCIATA* (DeGeer). The Green-striped Locust.
Acrydium viridifasciatum DeG., 57, III, 1773, 498, Plate 42, Fig. 6.
Locusta (*Tragocephala*) *viridifasciata* Harr., 71, 1841, 147; Id., 72, 1862, 182, Plate III, Fig. 2.
Tragocephala viridifasciata Scudd., 141, VII, 1862, 461; Id., 150, XVII, 1875, 481; Id., 153, IV, 1875, 80; Glov., 62, 1872, Plate V, Fig. 9; Thom., 206, V, 1873, 103, Plate I, Fig. 3; Id., 211, IX, 1880, 105, Figs. 13, 17; Stal., 200, I, 1873, 119; Riley, 117, VIII, 1876, 149, Fig. 46; Id., 214, I, 1878, 255, Fig. 94; Id., 122, II, 1884, 203, Fig. 285.
Chortophaga viridifasciata Sauss., 134, 1884, 72, Plate I, Figs. 7, 12; Fern., 53, 1888, 40, Fig. 15; Bl., 4, XXIII, 1891, 76; McN., 88, VI, 1891, 62; Beut., 3, VI, 1894, 295, Plate VIII, Fig. 9; Morse, VIII, 99, 1897, 35, 64, Plate 2, Fig. 18; Lugg., 84, 1898, 144, 147, Figs. 83-85; Scudd., 188, 1900, 31.
Locusta (*Tragocephala*) *infusata* Harr., 72, 1862, 181.
Tragocephala infusata Scudd., 141, VII, 1862, 461; Glov., 62, 1872, Plate X, Fig. 10; Thom., 206, V, 1873, 102, Plate I, Fig. 7.
Tragocephala viridifasciata infusata Scudd., 150, XVIII, 1875, 481; Thom., 211, IX, 1880, 106.
Chortophaga viridifasciata infusata Bl., 4, XXIII, 1891, 76.
Locusta (*Tragocephala*) *radiata* Harr., 72, 1862, 183.
Tomonotus zimmermanni Sauss., 128, II, 1861, 23.

Color dimorphic, either largely green with a small amount of brown upon the tegmina (*viridifasciata*) or wholly brown (*infusata*). Specimens are common, however, which can be referred to either



Fig. 50. *Chortophaga viridifasciata* (DeGeer). Nymph and adult female.
 (After Riley).

form, the color being a mixture. In the more pronounced green examples, the head, pronotum, outer face of hind femora and the basal two thirds of the median field of the tegmina are grass green; the

upper dorsal field, and apical third of tegmina, as well as a narrow stripe along their lower or costal margin are ash brown; the abdomen reddish brown. Rarely the head, pronotum and hind femora are reddish purple instead of green. In the brown form the apical halves of the tegmina are darker and their sides often contain a few light spots. The inner wings of both forms are transparent and yellow at base, the apical two-thirds fuliginous or smoky, the apex paler; an opaque dark bar is present along the middle of front margin. Hind tibiae brown or pale blue with a white ring near the base.

Measurements: Length of body, male, 20 mm., female, 26 mm.; of antennae, male, 8 mm., female, 7 mm.; of tegmina, male, 18.5 mm., female, 23 mm.; of hind femora, male, 13 mm., female, 15 mm.

This is the first locust to reach maturity in spring from hibernating nymphs, specimens having been taken in Vigo County as early as April 15th. It is a common species throughout the State, making its home in blue-grass pastures, and especially in the grassy tracts along rail fences between upland woods and cultivated fields and meadows. It also occurs on sunny sloping hillsides and railway embankments. In fact, mature individuals may occur anywhere in dry grassy places from mid-April till November 1st. In such localities the young, in company with those of *Arphia sulphurea*, may be seen on all sunny winter days when the mercury is above the freezing point. At such times they often climb or leap upon the lower rails of fences or sides of stumps, there resting in and apparently enjoying the sunshine. The species is said to be double brooded in some localities, but in Indiana, as far as known, it is single brooded, the young hatching in August and September and undergoing three or four moults before winter.

In this State, as elsewhere throughout its range, which includes the United States and Canada east of the Rocky Mountains, green females and brown males are the predominating forms, not more than 20 per cent. of the females in Indiana being brown, and a much smaller proportion of the males being green. The male of *viridifasciata*, when disturbed, usually flies but a few rods, moving in a circling or zigzag course, and producing a low but distinct shuffling or rattling noise during the whole of its flight. The female moves noiselessly and more directly to a greater distance.

XXVII. ENCOPTOLOPHUS Scudder (1875).

Body a little shorter and stouter than in *Chortophaga*, but compressed as there; the head more swollen. Vertex broadly triangular, the apical half sloping a little downward, the disk noticeably lower than the occiput, the lateral carinae low; the median present but terminating at middle of disk; the foveolae distinct, elongate triangular. Frontal costa narrow, strongly sulcate throughout in the male, but only above ocellus in the female. Antennae equaling the head and pronotum together in the female, a third longer in the male; the joints of apical half moderately flattened. Pronotum with its disk nearly flat, the front margin truncate, the hind margin forming a rather sharply marked right angle; the median carina distinct, a little higher on the prozona, cut into two nearly equal halves, by a distinct notch; the lateral carinae plainly visible only on the metazona. Lateral lobes of pronotum deeper than long, their disks concave and much wrinkled, their front and hind margins nearly vertical, the lower margin with its posterior half rounded, the anterior oblique, ascending. Tegmina rather broad and short, the apex broadly rounded, slightly surpassing the abdomen in both sexes; the intercalary vein distinctly nearer the ulnar than the median vein. Inner wings short and broad, pellucid or nearly so, the veins next the costal margin distinctly swollen. Hind femora a little shorter than the abdomen in the female; slightly surpassing it in the male.

Four species of *Encoptolophus* are known from the United States. Of these, one occurs in Indiana.

41. ENCOPTOLOPHUS SORDIDUS (Burmeister). The Clouded Locust.

Edipoda sordida Burm., 40, II, 1838, 643; Glov., 62, 1872, Plate X, Fig. 11; Thom., 206, V, 1873, 116; Pack., 215, II, 1880, 179, Plate I, Fig. 4.

Tragocephala sordida Stal., 200, I, 1873, 119; Thom., 211, IX, 1880, 107.

Encoptolophus sordidus Scudd., 150, XVII, 1875, 479; Id., 153, IV, 1875, 78; Id., 188, 1900, 32; Sauss., 134, 1884, 77; Comst., 41, 1888, 103, Fig. 93; Id., 42, 1895, 110, Fig. 121; Fern., 53, 1888, 41, Fig. 16; Bl., 4, XXIII, 1891, 77; Beut., 3, VI, 1894, 296, Plate X, Fig. 2; Morse, 99, VIII, 1897, 35, 66, Plate 2, Fig. 19; Lugg., 84, 1898, 147, Fig. 86.

Locusta nebulosa Harr., 71, 1841, 146; Id., 72, 1862, 181; Emm., 49, V, 1854, 146, Plate 9, Fig. 7.

Color, dull rusty, yellowish or smoky brown, varied with small mottlings of the darker and lighter shades. Pronotum in living specimens often with a distinct pinkish buff X-shaped mark on its

disk. Antennæ pale brown at base, the apical half darker. Tegmina with two pale transverse bars on the middle of sides, which contrast plainly with the larger dark patches between and on either side of them. Inner wings transparent yellowish at base; the apical half smoky brown, the apex darker. Hind femora indistinctly banded with dull yellowish and dark brown. Hind tibiae dusky brown with a pale ring near the base.



Fig. 51. *Encoptolophus sordidus* (Burm.). Male. (After Lugger.)

Measurements: Length of body, male, 22 mm., female, 29 mm.; of antennæ, male, 10 mm., female, 9 mm.; of tegmina, male, 19 mm., female, 24 mm.; of hind femora, male, 13.5 mm., female, 16 mm.

The clouded locust is common throughout the State, maturing in the central portion about August 1st, from eggs hatched in the spring, and existing till December 1st, provided the autumn is a favorable one. It frequents only dry upland timothy and clover meadows, blue-grass pastures, roadsides, etc. When living in woodland pastures it frequents the sunny spots, seldom alighting in the shade when flushed. The male stridulates on the wing during short flights, seldom, if ever, in the more prolonged ones, which it makes when frightened. The note is a harsh droning or buzzing sound, somewhat resembling that of a bumblebee, but louder. It is begun after the insect has risen three or four feet above the ground, and is continued until it begins to descend, being kept up continuously while it is flying horizontally. The females usually leap for the first two or three times they are disturbed, but if flushed a number of times they use the wings in endeavoring to escape.

XXVIII. CAMNULA Stal (1873).

Body short, the size below the average for the *Oedipodinae*, the head compressed. Vertex with its disk ovate-oblong in male, broader in female, its front half sloping downward, the apex rounded, the lateral carinae distinct, the median carina very faint in the female, absent in the male; the foveolæ indistinct, narrowly triangular. Frontal costa, not prominent, flat or nearly so, a little sulcate just below the ocellus. Antennæ short, filiform. Pronotum with its disk

flat, not rugose, the front margin truncate, the hind margin obtuse angled, the median carina low, of equal height throughout, cut with a small notch a little in front of the middle; the lateral carinae distinct on both prozona and metazona. Lateral lobes of pronotum, deeper than long, the front margin nearly vertical, the hind margin oblique, the lower margin as in *Encopitophus*. Tegmina narrow, surpassing the abdomen; the apical third remotely reticulate, the cells quadrate. Inner wings pellucid with dusky venules. Hind femora equaling or slightly exceeding the abdomen; their upper margin sharp and somewhat crested. Valves of ovipositor strongly exerted. One species is found throughout the northernmost United States and Canada from the Atlantic to the Pacific. It occurs rarely in northern Indiana.

42. CAMNULA PELLUCIDA (Scudder). The Clear-winged Locust.

(*Edipoda pellucida* Scudd., 141, VII, 1862, 472; Glov., 60, 1870, 78; Id., 62, 1872, Plate XII, Fig. 20; Thom., 206, V, 1873, 137.

Camnula pellucida Scudd., 148, I, 1874, 378; Id., 188, 1900, 32; Thom., 211, IX, 1880, 118; Id., 215, II, 1880, 242, Fig. 10; Riley, 127, XXV, 1891, 32, Fig. 10; Sauss., 134, 1884, 81; Fern, 53, 1888, 41, Fig. 17; Brun., 26, XXVII, 1892, 12; Id., 28, XXVIII, 1893, 34, Fig. 18; Id., 30, 1893, 463, Fig. 107; Id., 34, 1896, 123, Figs. 25, 26; Morse, VIII, 99, 1897, 35, 80, Plate 2, Fig. 20; Lugg., 84, 1898, 148, Figs. 87, 88.

(*Edipoda atrox* Scudd., 147, 1872, 253; Glov., 60, 1871, 77, Fig. 10; Id., 62, 1872, Plate VIII, Fig. 3; Id., 63, 1874, 137, Fig. 10; Thom., 206, V, 1873, 136; Riley, 214, I, 1878, 454, Fig. 109.

General color, light brown; face, reddish brown. Antennae yellowish at base, the apical half dusky. A dark triangular spot behind eye, and an oblong vertical black spot on the front half of lateral lobe of pronotum. Tegmina smoky brown, with several darker rounded spots on sides; these separated by lighter yellowish blotches; the dorsal surface dark brown, with a yellowish brown stripe along each humeral angle. Inner wings transparent, with dark nervules. Hind femora yellowish brown, with two or three blackish bars on the outer face; the knees fuscous. Hind tibiae yellowish brown; the basal fourth lighter. Abdomen yellowish beneath, the sides darker.

"In the markings of the tegmina, form and color, *pellucida* looks like a diminutive *Hippiscus*. It varies much in size and tegminal markings."

Measurements: Length of body, male, 19 mm., female, 22 mm.; of antennae, male and female, 7 mm.; of tegmina, male, 17 mm., female, 20 mm.; of hind femora, male, 12 mm., female, 13 mm.

As noted above, this is a species of northern range. It has been taken in Indiana but once, near Bass Lake, Starke County, on August 21, 1902. Here a half dozen specimens, all that could be found during a two-hours' search, were secured from a low, marshy tract, on which the grass had been cropped short. When flushed, the males flew noiselessly 30 to 50 feet, then dropped down and squatted low between the grass blades. The single female was more clumsy and did not take to wing; all were found within an area of 100 square feet. It is probable that the species occurs in isolated localities throughout the northern third of the State. In New England Morse says that it begins to mature about July 1st, and may be found during the rest of the season. "It is extremely common, even abundant locally, throughout the northern part of New England, being probably the most numerous in point of individuals of any of our *Oedipodinae*. It is found in dry grassy pastures and other untilled lands, preferably on high ground. Its flight is silent or slightly rustling, usually low, short and direct, resembling that of a large *Melanoplus*; when with the wind, however, it is occasionally prolonged for several rods in a straight line."

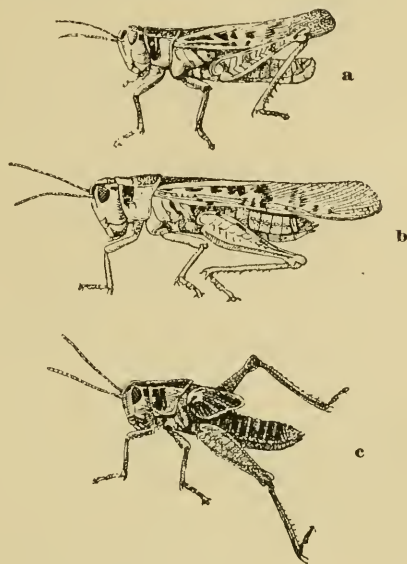


Fig. 52. *Camnula pellucida* (Seudd.). a, adult male; b, female; c, nymph; slightly enlarged.
(After Simpson.)

XXIX. HIPPISCUS Saussure (1861).

Species of large size and robust form. Head large, sub-globose, the cheeks swollen. Vertex with the disk usually broadly triangular, the apex rounded or obtusely angulate and sloping more or less downward; the lateral carinae distinct, but not sharp; the median carina present, at least on posterior half, and continued back over the occiput in the form of a small central ridge; the foveolae present, but not prominent, usually triangular in form. Antennae but little, if any, longer than head and pronotum together, filiform, the joints of

apical halves a little flattened. Pronotum with its disk flat, usually rugose and bearing a number of rounded or oblong tubercles; the front margin truncate, the hind margin usually obtuse, or right angled; the median carina rather prominent, and cut once by the principal sulcus; the lateral carinae extending a short distance in front of this sulcus, but not cut by it. Lateral lobes of the pronotum about as long as deep, constricted near the middle; the front margin a little sinuate, the hind margin oblique; the lower margin with its posterior half rounded, the anterior half oblique, directed upward, the posterior angle usually broadly rounded. Tegmina considerably exceeding the abdomen; their sides usually with a number of large rounded or squarish dark spots. Inner wings with their basal halves red or yellow, the apical halves with a broad fuscous arcuate band, narrowing toward the anal angle. Hind femora stout, depressed, dilated.

Thirty-seven of these heavy bodied locusts are catalogued by Scudder as occurring in the United States, most of them being found only west of the Mississippi River. Four are known from Indiana, and probably one or two others will, in time, be found to inhabit the State.

KEY TO INDIANA SPECIES OF HIPPISCUS.

- a.* Hind margin of pronotum acutely angled; the prozona much shorter than the metazona; vertex with the front half of disk prolonged, narrowing gradually; the ulnar area of tegmina dark, but without distinct spots; inner wings pinkish red at base.....

43 *tuberculatus*, p. 265

- aa.* Hind margin of pronotum right angled or obtuse angled; the prozona nearly as long as the metazona; vertex with the front half of disk not prolonged, narrowing rapidly; the ulnar area of tegmina distinctly spotted; the inner wings (except rarely in *haldemani*) yellow or orange red at base.

- b.* Frontal costal strongly sulcate below the ocellus, and distinctly narrowed at its upper extremity; vertex with the disk, not or but faintly divided by cross carinae into four sub-equal parts; spurs at opposite sides of apex of hind tibiae nearly equal.

- c.* Tubercles on disk of metazona rounded or oblong, not forming ridges parallel to the hind margins; inner face of hind femora banded with black, blue at base.....

44 *phannicopterus*, p. 267

- cc.* Tubercles on disk of metazona more or less united to form oblique ridges parallel to the hind margin; inner face of hind femora uniform yellowish.....45 *haldemani*, p. 269

- bb.* Frontal costa but little sulcate below the ocellus and not narrowed at the upper extremity; vertex with the disk divided by transverse and lengthwise carinae into four sub-equal parts; spurs at opposite sides of the apex of hind tibiae very unequal in length. A distinct broad, buff X-shaped mark usually present on disk of pronotum.....46 *rugosus*, p. 270

43. *HIPPISCUS TUBERCULATUS* (Palisot de Beauvois). The Coral-winged Locust.

Acrydium tuberculatum Pal. de Beauv., 108, 1805, 200, Plate 4, Fig. 1.

Hippiscus tuberculatus Sauss., 134, 1884, 87; Fern., 53, 1888, 42; Scudd., 167, VI, 1892, 269, 303; Id., 188, 1900, 33; Beut., 3, VI, 1894, 297, Plate X, Fig. 3; Morse, 99, VIII, 1897, 36, 81, Plate 2, Fig. 21; Brun., 34, 1897, 131, Fig. 31; Bl., 15, XXX, 1898, 61; Id., 16, 1899, 235, Fig. 61; Lugg., 84, 1898, 153, Figs., 89-91.

Locusta corallina Harr., 71, 1841, 142; Id., 72, 1862, 176; Emm., 49, V, 1854, 146.

Edipoda phenicoptera Scudd., 141, VII, 1862, 468; Glov., 62, 1872, Plate V, Fig. 4; Thom., 206, V, 1873, 135; Riley, 117, VIII, 1876, 104, Fig. 41; Id. 214, I, 1877, 228, Fig. 7.

Hippiscus phenicopterus Scudd., 148, 1874, 377; Thom., 211, 1880, 95, 117, Fig. 18; Bl., 4, XXIII, 1891, 79.

Edipoda oblitterata Burm., 40, II, 1838, 643.

Vertex prominent, its front half prolonged, the lateral carinae distinct, not uniting, but continuous with those of the frontal costa; the median carina reaching center of disk; the foveolæ triangular, very small. Frontal costa sulcate below the ocellus; the upper third a little narrowed. Antennæ short, equaling the length of head and pronotum; the joints a little flattened. Pronotum with its disk flat, but little wrinkled; granulate and bearing a few small rounded black tubercles; the hind margin acute angled, sometimes right angled in the male; the median carina low, but distinct, cut much in front of the middle by the principal sulcus; lateral carinae distinct. Hind femora very broad, the upper and lower carinae prominent and arcuate.

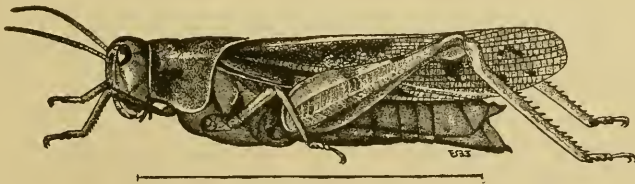


Fig. 53. *Hippiscus tuberculatus* (Pal. de Beauv). Female. (After Luggler).

General color, ash brown, darker above; the cheeks paler. Antennæ yellowish at base, the apical two-thirds gradually darkening to fuscous. Pronotum with a short, dark brown, lengthwise bar on middle of lateral lobes, below which the lobe is usually lighter than above. Tegmina blotched with fuscous and black, the humeral angle light brown; the dark color of discoidal and ulnar areas usually unbroken; some scattered dark blotches on apical third. Wings bright

coral red (rarely yellow) at base, bordered without by an arcuate fuscous band which reaches the anal angle; a broad marginal ray of fuscous extends long the front or costal margin, nearly to base. Hind femora with the basal half of inner face black (prussian blue in life), the apical half yellow with a median black bar; the outer face with indistinct bars of black. Hind tibiae dull yellow, sometimes with an orange tint.

Measurements: Length of body, male, 30 mm., female, 43 mm.; of antennæ, male, 13 mm., female, 14 mm.; of pronotum, male, 8 mm., female, 11 mm.; of tegmina, male, 31 mm., female, 41 mm.; of hind femora, male, 18 mm., female, 23 mm.

The female of the coral-winged locust is the largest and most bulky of our Indiana *Oedipodinae*. The males, as the measurements show, are much smaller. This locust probably occurs throughout the State, but is most abundant in the southern or driftless portion, where the soil is poor and the hills high; and in the northwest portion, where the sand-covered area is extensive. It has not been noted

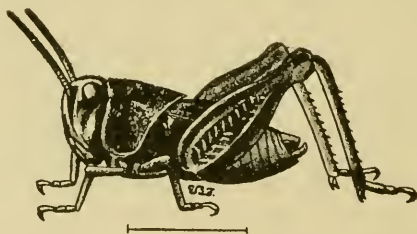


Fig. 54. *Hippiacus tuberculatus*. Young. (After Lugger).

by me in the richer and more level regions of the central and eastern portions of the State. The winter is passed in the nymph stage, the young being "curious little depressed, toad-like objects" of a dull leaden color. Mature examples have been taken in Monroe County as early as April 20th, and in Crawford County as late as July 10th. The northern examples are smaller, darker colored, and may probably be found a month later.

This locust frequents, for the most part, timothy meadows, upland pastures, roadsides, and especially bare or scantily vegetated slopes and sandy plains. When in flight it is very conspicuous, owing to its large size and bright-colored inner wings. The males are ready and active flyers, moving rapidly for quite a distance, making, meanwhile, a loud rattling note which can be heard at a distance of several rods. The females seldom take to wing, but leap clumsily when approached, and are more readily captured. The general range of *tuberculatus*

is given by Scudder as "North America, east of the Rocky Mountains, rare southwardly."

44. *HIPPISCUS PHENICOPTERUS* (Germar). The Orange-winged Locust.
Edipoda phenicoptera Germ., 58, II, 1838, 643.
Hippiscus phenicopterus Sauss., 134, 1884, 87; McN., 88, VI, 1891, 63;
 Scudd., 167, VI, 1892, 267, 274, 285; Id., 188, 1900, 33; Beut.,
 3, VII, 1894, 298, Plate IX, Fig. 4.
Edipoda discoidea Serv., 196, 1839, 724; Glov., 62, 1872, Plate III,
 Figs. 3, 7; Thom., 206, V, 1873, 133.
Hippiscus discoidens Stal., 200, I, 1873, 121; Thom., 211, IX, 1880,
 89, 116; Comst., 41, 1888, 104.

Vertex prominent, the basal two-thirds broad, the lateral carinae distinct, suddenly converging opposite the front half of eyes, but not uniting in front; the median carina low, reaching center of disk; traces of a cross carina on posterior half of disk in female; foveolae small, elongate U-shaped. Frontal costa rather narrow, sulcate from a little above the ocellus to the base; the upper third narrower, punctate. Antennae a little shorter than head and pronotum in the female; equaling their length in the male; filiform, the joints a little flattened. Pronotum with its disk flat, a little wrinkled on the prozona, covered somewhat regularly with small rounded tubercles, these more prominent in the female; the hind margin right-angled in the male, obtuse-angled in the female; the median carina low but distinct, cut in front of middle by the principal sulcus, the lateral carinae distinct only on metazona. Tegmina of both sexes surpassing the abdomen; the basal lobe of lower margin noticeably expanded, especially in the female. Hind femora broadly dilated; the upper and lower carinae much elevated and sharp.

General color, ash or reddish brown; the males darker. Face ash brown or clay yellow. Occiput and disk of pronotum dark brown. All of these parts, as well as the upper and lower outer faces of the hind femora are often prettily tinged with greenish. Tegmina, ash brown, with numerous large dark brown or blackish spots; those of the female more distinct, the light interspaces being wider; the largest of these spots on the lower third being just behind the expansion noted above. Wings deep orange (rarely yellow) at base; outside of this and just beyond the middle a curved black band crosses from the costal margin to the anal angle; the apical fourth transparent and smoky, the extreme tip with one or two fuscous blotches in the male; a humeral bar or stripe of black reaches nearly to the base of the front portion. Inner face of hind femora deep blue, with an orange bar near the apex; outer face reddish or yellow-

ish brown, with three black bars on the upper half. Hind tibiae yellowish, often tinged with orange, the spines tipped with black.

Measurements: Length of body, male, 31 mm., female 44 mm.; of antennæ, male, 12.5 mm., female, 13.5 mm.; of pronotum, male, 8.5 mm., female, 11 mm.; of tegmina, male, 31 mm., female, 40 mm.; of hind femora, male, 18 mm., female, 23 mm.

This is a locust of southern range which has been taken in Indiana only in Crawford, Lawrence and Jennings counties. In the vicinity of Wyandotte Cave, Crawford County, it is, in the latter half of June and first part of July, one of the most common of the *Oedipodinae*. It occurs only on the uplands, where it frequents grain fields, open bare places in the woods, roadsides and timothy meadows. The male, when flushed, flies rapidly for a long distance, making a low rattling note while in the air; the female, as in kindred species, is too heavy bodied to take to wing gracefully, and therefore more often moves by leaping. In the vicinity of North Vernon and Mitchell, males only were seen. This locust probably occurs throughout the southern third of the State, and perhaps winters in the nymph stage. Its general range includes the southern United States east of the Great Plains.

45. *HIPPISCUS HALDEMANII* (Scudder). Haldeman's Locust.

Edipoda haldemanii Scudd., 147, 1872, 251; Glov., 62, 1872, Plate XIII, Fig. 3; Thom., 206, V, 1873, 130.

Hippiscus haldemanii Scudd., 156, II, 1876, 264; Id., 167, VI, 1892, 267, 286; Id., 188, 1900, 32; Lugg., 84, 1898, 156, Fig. 93.

Hippicus nanus Sauss., 134, 1884, 86.

Vertex broad, its disk sub-quadrate, often containing several minute tubercles, the lateral carinæ low, distinctly rounded; the median carina reaching the center, with sometimes traces of a cross carina; the foveolæ small but distinct, triangular. Face nearly vertical, the frontal costa broad, sulcate from a little above the ocellus downward, less so in the female, the upper third distinctly narrowed. Antennæ slender, about the length of head and pronotum together. Pronotum short; the prozona sub-cylindrical, constricted; the disk much wrinkled and rugose, bearing numerous elongate tubercles which lie obliquely and more or less parallel to the hind margin; the latter right-angled in the male, obtuse-angled in the female; the median carina low, indistinct on the prozona, cut a little in front of the middle by the principal sulcus; lateral carinæ distinct on hind part of prozona and front half of metazona. Tegmina surpassing the abdomen about one-fourth their length. Hind femora relatively slender, much narrower proportionally than in any other of our species of *Hippiscus*,

reaching the tip of the abdomen in the female, slightly passing it in the male.

General color, grayish brown varied with numerous dark spots. Face, ash gray, the cheeks and a spot back of the eye, lighter; the vertex, occiput and disk of pronotum darker. A black bar on middle of lateral lobe of pronotum. Tegmina with a narrow yellowish line along each humeral angle, the dorsal area, brownish, unbroken; the sides with a number of oblong dark brown spots, separated by irregu-

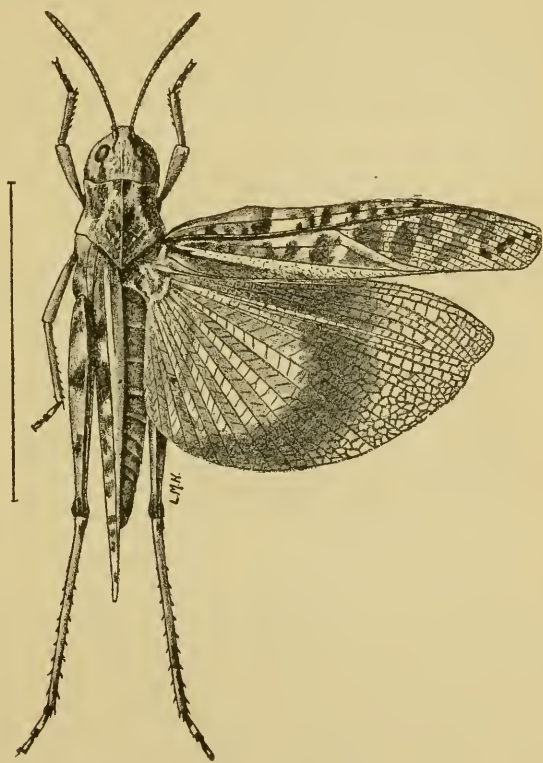


Fig. 55. *Hippiscus haldemanni* (Scudder). Female. (After Lugger).

lar grayish bars; those on apical third smaller and rounded. Wings with the basal half lemon yellow, orange red, or, rarely, pinkish; the remaining portion as in *phanicopterus*. Hind femora with the inner face bright yellow;* the outer face brownish yellow with traces of three very oblique cross bars. Hind tibiae light yellow, tinged with orange in the male.

* Thomas says: "Inside of posterior femora and the posterior tibiae a bright coral red," but this does not hold good of Indiana specimens.

Measurements: Length of body, male, 27 mm., female, 44 mm.; of antennæ, male, 12 mm., female, 14 mm.; of pronotum, male, 7 mm., female, 10 mm.; of tegmina, male, 27 mm., female, 38 mm.; of hind femora, male, 16 mm., female, 22 mm.

This species has been taken in Indiana only near Pine, Lake County, where my assistant, Mr. L. E. Daniels, took eight specimens on June 20, 1902. They were found on open, sparsely vegetated sandy tracts, about a fourth of a mile back from the shore of Lake Michigan. Nothing distinctive of their habits was noted. One of the females taken has the inner wings pinkish or coral red, as in *tuberculatus*; two have them orange red, the others, yellow. Of the four males, two have yellow and two orange colored wings. This is the most eastern record for the species, its range, according to Scudder, being from Moline, Illinois, westward to the Rocky Mountains. It probably occurs in this State only in the sand-covered area of the northwestern portion.

46. *HIPPISCUS RUGOSUS* (Scudder). The Lubberly Locust.

Edipoda rugosa Scudd., 141, VII, 1862, 469; Glov., 62, 1872, Plate XII, Fig. 8; Thom., 206, V, 1873, 132.

Hippiscus rugosus Scudd., 148, I, 1874, 377; Id., 167, VI, 1892, 268, 287; Id., 188, 1900, 33; Sauss., 134, 1884, 85; Fern., 53, 1888, 42; Bl., 4, XXIII, 1891, 78; Morse, 99, VIII, 1897, 36, 81, Plate 2, Fig. 22; Lugg., 84, 1898, 149.

Hippiscus corallipes rugosus Thom., 211, IX, 1880, 89, 115.

Hippiscus variegatus Scudd., 167, VI, 1892, 268, 301; Id., 188, 1900, 33; Brun., 34, 1896, 131; Id., 36, 1899, 271; Lugg., 84, 1898, 157, Fig. 94.

A rather bulky and short-bodied form. Vertex convex, the disk indistinct, and sloping downward, broader than long in both sexes, the lateral carinæ dull, low; the median carina extending to front border, and with a cross carina dividing the disk into four sub-equal portions, the front pair being the more distinct; lateral foveolæ, shallow, elongate triangular. Frontal costa broad, flat, punctate, slightly sulcate just below the ocellus. Antennæ about as long as head and pronotum in the female, a third longer in the male. Pronotum with the disk flat or nearly so, the metazonal portion not greatly widened, the hind margin obtuse-angled, the surface bearing numerous low, oblong or longitudinal, glistening tubercles; the median carina low, cut very near the middle by the principal sulcus; the lateral carinæ distinct on the metazona; the lateral lobes of metazona densely punctate. Tegmina relatively broad, exceeding the abdomen in both sexes. Hind femora moderately slender, equaling or surpassing the abdomen by one-fourth their length, the basal half depressed, dilated.

General color, light to dark brown, the face and abdomen brownish yellow; the disk of pronotum with a pale, X-shaped stripe, not always present in the female. Antennæ yellow at base, the apical half reddish fuscous. Tegmina ash gray, often darker in the male, the sides and dorsal area with numerous dark brown or fuscous oblong or rounded spots, those on center of sides larger; the apical third often semi-transparent, with the spots much smaller and more irregular in shape. Wings with the basal half varying from a pallid tint through pale lemon yellow to deep orange; the outer half with the curved black band and transparent apex as in *phænicopterus*. Hind femora bright yellow within, with three transverse bars of black; dull clay yellow without, with three more or less distinct, very oblique fuscous bars. Hind tibiæ yellow, with a paler ring near the base.

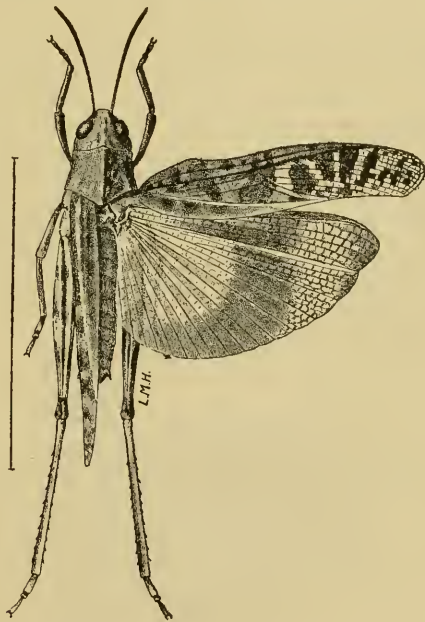


Fig. 56. *Hippiscus rugosus* (Scudder). Male. (After Lugger.)

Measurements: Length of body, male, 28 mm., female, 37 mm.; of antennæ, male, 13 mm., female, 12 mm.; of pronotum, male, 7 mm., female, 9 mm.; of tegmina, male, 27 mm., female, 34 mm.; of hind femora, male, 18 mm., female, 22 mm.

This is the most common species of *Hippiscus* in the State, being especially abundant in the central and southern portions, but scarce in the north, where it has been collected only in Fulton and Marshall

counties. In central Indiana it begins to reach maturity about July 20th, from eggs hatched in the spring. Like others of its kind, it frequents only dry, upland localities, being especially abundant in open woodland pastures, timothy and clover meadows, along roadsides and rail fences. The males are shy, usually taking to flight when an intruder is a rod away and moving in a straight line in the direction they happen to be headed, without noise, save the rustling of their wings. The females are very clumsy, being readily picked up with the fingers. I have often placed one of them on the palm of one hand and with the other stroked gently its back and antennæ without having it attempt to escape.

Mating takes place in late August and September, and the males then mostly perish, while the females are to be found much longer, sometimes as late as November 5th. Orange-winged females of *rugosus* are more common than males; probably one third of them having the wings of that hue. It ranges over the eastern United States east of the Rocky Mountains.

From the study of type specimens of Scudder's so-called *H. variegatus* and of a large number of examples taken in the field, I have concluded that it is but a little stouter bodied, lighter colored form of *rugosus*, and have therefore combined the two species under the latter name. Intermediate specimens, varying in length of tegmina and size and position of tegminal spots are common. With numerous examples at hand it is impossible to separate the two forms.

XXX. DISSOSTEIRA Scudder (1876).

Body slender, compressed. Vertex with the disk sub-pentagonal or ovate; the front half a little downward sloping, its front margin angulate; the lateral carinæ low; the median carina present but indistinct; the foveolæ short, triangular. Frontal costa sulcate, a little narrowed below the ocellus. Pronotum with disk of prozona sloping, that of metazona flat; the front margin truncate, the hind margin obtuse-angled; the median carina high and sharp, and on the metazona strongly arched, cut in front of the middle by a deep but narrow notch; lateral carinæ rounded, cut by the principal sulcus and obsolete in front of it. Lateral lobes of pronotum deeper than long, the front margin vertical, the hind margin oblique, the lower margin with its posterior half rounded, the anterior half oblique. Tegmina broad, much exceeding the abdomen; the whole of apical third membranaceous; the intercalary vein very distinct and nearly intermediate between the median and ulnar veins. Inner wings long and wide,

black, with a narrow yellowish outer border; the apex fuscous. Hind femora slender, a little shorter than abdomen in both sexes.

Four species of the genus are accredited to the United States. Of these, one occurs in Indiana.

47. *DISSOSTEIRA CAROLINA* (Linnaeus). The Carolina Locust. The Black-winged Locust.

Gryllus (*Locusta*) *carolinus* L., 81, I, 1758, 433.

Locusta carolina Harr., 70, 1833, 583; Id., 72, 1862, 176, Plate 3, Fig. 3; Emm., 49, V, 1854, 145, Plate 9, Fig. 9; Rathv., 109, 1862, 386, Figs. 26, 26a.

Edipoda carolina Burm., 40, II, 1838, 643; Serv., 196, 1839, 722; Glov., 62, 1872, Plate V, Fig. 3; Thom., 206, V, 1873, 117; Id., 211, IX, 1880, 88, 111.

Dissosteira carolina Scudd., 159, 1876, 511; Id., 180, VIII, 1897, 100; Id., 188, 1900, 36; Sauss., 134, 1884, 137; McNeill, 87, XIX, 1887, 58; Fern., 53, 1888, 43; Bl. 4, XXIII, 1891, 78; Id., 16, 1899, 242, Fig. 69; Smith, 197, XC, 1892, 6, 12, 34, Plate 1, Fig. 4k; Beut., 3, VI, 1894, 298, Plate X, Fig. 6; Morse 99, VIII, 1897, 35, 87; Lugg., 84, 1898, 158, Fig. 95.

General color varying from light grayish yellow through bright reddish brown to dark fuscous; usually dull ashy brown, sprinkled with numerous small dusky spots; these most numerous on the pronotum and tegmina, on the latter sometimes forming three more or less distinct cross bands. Wings deep black except the outer border,



Fig. 57. *Dissosteira carolina* (Linn.). Female. (After Lugg.)

which is pale greenish yellow; the apex smoky gray with a few darker spots. Hind femora with three broad black bands on the inner face. Hind tibiae yellowish or dusky.

Measurements: Length of body, male, 30 mm., female, 35 mm.; of antennæ, male, 11 mm., female, 13 mm.; of pronotum, male, 7 mm., female, 10 mm.; of tegmina, male, 34 mm., female, 41 mm.; of hind femora, male, 16 mm., female, 18 mm.

The black winged locust occurs everywhere throughout the State and to the casual observer appears to be our most common species, but there are a dozen which are more abundant. Its numbers appear multiplied because it frequents the highways and by-ways of man rather than the pastures and meadows where other grasshoppers are wont to congregate. Moreover, when disturbed, it more often betakes itself to the bare earth than to the green grass. Why this absurd taste? asks the person uninitiated in the doings of nature's objects. For the simple reason that the dust of the roadside and the gravel ballast of the railway correspond so closely with the color of its back that its best friends and worst enemies will overlook it if it will only remain quiet. Yea, even that sharp-eyed connoisseur of grasshopper tid-bits, the turkey gobbler, oftentimes walks right over it, mistaking it for a wayside pebble.

Mature specimens of this "carolina locust," hatched from eggs in spring, have been taken in Vigo County as early as June 14th and as late as November 22d. It is usually common and mating by July 5th. Either there are two broods each year, or else the eggs hatch at irregular intervals, as freshly moulted individuals have been observed on a number of dates in September, and as late as October 14th. On one occasion, while passing through a wheat field in late September, I observed clinging to the stems of weeds, several specimens of what appeared to be the bodies of grasshoppers with the wings of the common sulphur-yellow butterfly attached to them. Such a combination aroused my curiosity, but a closer examination proved them to be specimens of this common black-winged locust which had just moulted for the last time, and spread out their soft wings to dry. The inner wings, instead of being black, were light yellow, but in three or four hours thereafter had changed to their usual color.

This locust is often seen along the walks and in the yards of our larger cities and I have seen specimens about the base of the Soldiers' Monument in the very center of the city of Indianapolis. Both sexes use the wings almost wholly in their travels, and fly in a noiseless zigzag manner for quite a distance when flushed. Their hind legs are used only in giving themselves an upward impetus from the ground, and hence are much smaller proportionally than are those of such locusts as leap rather than fly, while their wings are much longer and stronger.

The range of *D. carolina* is a most extensive one, embracing the United States and Canada from ocean to ocean.

XXXI. SPHARAGEMON Scudder (1875).

Body slender, more or less compressed. Head rather swollen above, the vertex shaped much as in *Dissosteira*, but the lateral carinæ converging more rapidly; the median carina and angled front margin absent, the foveolæ wider and more distinct. Frontal costa narrow, sulcate, at least below the ocellus. Antennæ in both sexes about as long as hind femora; filiform, the joints of basal third a little flattened. Pronotum with the disk of metazona flat, that of prozona with the sides sloping; the median carina high and strongly compressed, cut a little in front of the middle by a deep but narrow notch; the lateral lobes as in *Dissosteira*. Tegmina relatively shorter than in *Dissosteira*, the intercalary vein less distinct and nearer the median than the ulnar vein. Inner wings yellow, with a dark curved median band. Hind femora rather stout and short, equaling, or a little exceeding, the tip of abdomen. Hind tibiæ, in our species, with at least the apical half red. Valves of ovipositor short; but little exerted.

This genus is closely related to *Dissosteira*, and Saussure, in his *Prodromus*, has placed it as a sub-genus under that one. Eight species are known from the United States. Of these, two have been taken in Indiana.

KEY TO INDIANA SPECIES OF SPHARAGEMON.

- a. Size, large; the notch of median carina of pronotum vertical. Hind tibiæ with a distinct pale ring on basal third, followed by a black one of equal width, the apical half coral red. 48 *bolli*, p. 275
- aa. Size, small; notch of median carina of pronotum distinctly oblique. Hind tibiæ coral red, sometimes paler at base, but without distinct white and black rings. 49 *wyomingianum*, p. 277

48. SPHARAGEMON BOLLI Scudder. Boll's Locust.

Spharagemon bolli Scudd., 149, XVII, 1875, 469; Id., 153, IV, 1875, 68; Id., 168, XXIII, 1893, 77; Id., 188, 1900, 37; McN., 88, VI, 1891, 64; Bl., 6, XXIV, 1892, 30; Morse, 95, XXVI, 1894, 227, 236, Figs. 6, 7; Id., 97, VII, 1895, 290; Id., 99, VIII, 1897, 37, 88, Plate 2, Fig. 26; Beut., 3, VI, 1894, 300, Plate X, Fig. 1; Lugg., 84, 1898, 163, Fig. 98.

Dissosteira (Spharagemon) bolli Sauss., 134, 1884, 140.

Dissosteira bolli Fern., 53, 1888, 43.

Spharagemon balteatum Scudd., 149, XVII, 1875, 469; Id., 153, IV, 1875, 68; Bl., 4, XXIII, 1891, 78.

Ground color variable, that of the male being usually grayish or fuscous, that of the female rusty brown or pale buff; the face grayish or yellowish. Antennæ brownish or grayish at base, fuscous at apex. Tegmina sprinkled throughout with minute blackish spots. In the males these spots are aggregated into three more or less distinct dark cross bars; in the female only faint traces of these bars are visible. Inner wings light greenish yellow at the base, with a broad median curved band of blackish or piceous which stops a little short of the anal angle; from this band near the front margin a black bar reaches

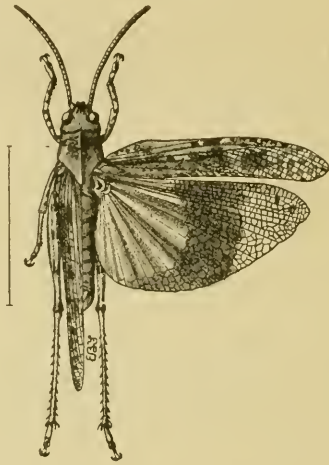


Fig. 58. *Spharagemon bollii* Scudder. Male.
(After Lugger.)

back half way through the yellow. Apical third of wing transparent smoky, the extreme tip in the male being often of the same hue as the median band. Hind femora with alternating bars of black and yellow, three each, on the inner face; the outer face dull yellowish or grayish brown with three or four oblique indistinct dark brown bands.

The median carina of pronotum in the male is higher than in the female, that portion on the metazona being more elevated in front than behind. Other structural characters are given under the generic heading.

Measurements: Length of body, male, 25 mm., female, 33 mm.; of antennæ, male, 14 mm., female, 16 mm.; of pronotum, male, 7 mm., female, 9 mm.; of tegmina, male, 27 mm., female, 32 mm.; of hind femora, male, 16 mm., female, 19 mm.

This is a common locust throughout the central and southern thirds of the State, but is less numerous northward, where it seems to be replaced in part by the next species, though it has been taken in Starke and Lake counties. It frequents paths and bare places in dry upland woodland pastures, especially those which include the slopes of high hills, roadsides and stubble fields. In the northern counties it is found most abundantly along the sandy edges of woodlands and in old fields. In Crawford County mature specimens from eggs hatched in spring, have been taken on June 25th; in Vigo County, on June 30th. The males fly much farther than the females and on arising from the ground emit a short and rather low rattling note. The females are clumsy in their movements, and prefer, after being flushed once or twice, to lie still when approached, as close to the ground as possible, relying upon their protective coloration to prevent discovery.

Individuals of both this species and *D. carolina* have, in late summer, a peculiar habit of sustaining themselves in the air, about three feet above the ground, for several minutes. While poising in this manner above one spot, they make a dry, rustling note, which is perhaps a call to some nearby member of the opposite sex. *S. bolli* ranges from New England to Georgia, Texas and Nebraska.

49. SPHARAGEMON WYOMINGIANUM (Thomas). The Mottled Sand Locust. *Edipoda wyomingiana* Thom., 205, 1872, 462; Id., 206, V, 1873, 113; *Glov.*, 62, 1874, Plate XIV, Fig. 1; Plate XV, Fig. 2.
Spharagemon wyomingianum Scudd., 149, XVII, 1875, 468; Id., 153, IV, 1875, 67, 69; Id., 188, 1900, 38; Bl., 15, XXX, 1898, 61.
Spharagemon collare wyomingianum Morse, 97, VII, 1895, 298.
Spharagemon collare McN., 88, VI, 1891, 64.
Spharagemon oculatum Morse, 95, XXVI, 1894, 232, 239, Fig. 8; Bl., 11, XXVI, 1894, 218; Scudd., 188, 1900, 37.

General color, pale yellowish or pinkish brown, everywhere sprinkled and spotted with darker brown or fuscous. Face ash gray or yellowish, sprinkled with minute darker spots. Antennæ fuscous at tip, lighter toward base. Sides of pronotum with two indistinct dusky bands, the upper in the place of the lateral carinæ on the prozona. Tegmina with three transverse bars of fuscous spots; the dorsal field often brownish red. Inner wings similar to those of *bolli*, the median black band narrower toward the anal angle which it reaches. Hind femora pale brown or gray on outer face with traces of four fuscous cross bars; within sulphur yellow, with four more or less complete black bars. Hind tibiæ coral red or pinkish, paler at base; spines with extreme tips black.

The eyes of male of this species are larger and more prominent than usual. The vertex, viewed from above, is about as broad as the eye, with a faint trace of median carina on the posterior half. Pronotum with the disk flat on metazona, somewhat sloping on prozona, slightly angulate in front, acute angled behind; median carina high, compressed, arched, especially on metazona, the prozona in the male with crest of carina distinctly sloping toward the head; the notch plainly oblique and very narrow. Tegmina surpassing the femora by about one-third their own length. In most specimens the legs and the ventral portion of body are very pubescent, with rather long, grayish hairs.

Measurements: Length of body, male, 19 mm., female, 24 mm.; of antennæ, male, 12 mm., female, 11.5 mm.; of pronotum, male, 5 mm., female, 6.5 mm.; of tegmina, male, 19 mm., female, 23 mm.; of hind femora, male, 11 mm., female, 13 mm.

This small but handsome locust is quite common in the sand covered areas of the northern third of the State, having been taken in Fulton, Marshall, Lake, Porter, LaPorte, Starke, Kosciusko and Steuben counties. The earliest date at which it has been taken is July 14th, in Fulton County, when it was found in numbers and had probably been mature for a week or longer. It occurs most abundantly along the thinly vegetated sandy tracts twenty rods or more back from the water margin of lakes, in old sandy cultivated fields and along railways and roadsides. In such localities it is often found in company with *Psinidia fenestralis* and less frequently with *S. bolli*. It seldom leaps when disturbed, but uses the wings to propel itself in a flight of about 30 yards; the males making a faint crackling noise as they clear themselves from the earth, while the females are noiseless. In a corn field near Lake Maxinkuckee, I found *wyomingianum* very common on August 17, 1893, over about two acres of the most sandy portion. Resting on the soil between the rows, they were very difficult of detection, and eight times out of ten were not seen until flushed, unless they had previously been "marked down" as they alighted. A few were also taken from the sandy margin of the lake, but careful search over a wide extent of territory failed to reveal them elsewhere. It will probably be found in the vicinity of most of the lakes of the State. It is more frequent northward and westward, but has been taken in Maryland and New York, and may possibly occur in the sand covered area of southwestern Indiana.

XXXII. MESTOBREGMA Scudder (1876).

Size small. Body slender, compressed. Disk of vertex with its posterior portion short and broad, the front portion narrowing rapidly and sloping strongly downward to form the sides of the frontal costa; the lateral carinae high and sharp, the median carina wanting; the foveolæ, in our species, rather prominent, triangular. Frontal costa narrow, sulcate throughout, a little constricted above the ocellus. Antennæ about as long as hind femora, the basal joints so depressed as to form one sharp edge. Pronotum moderately constricted in the middle, the front margin truncate, the hind margin right-angled, the disk wrinkled, and bearing a number of small, ob-oblique tubercles; the median carina sharp, slightly higher on the prozona, notched twice in front of the middle; the lateral carinae rounded, visible only on the metazona. Lateral lobes of pronotum deeper than long, the front margin almost vertical, the hind one a little concave, the lower margin oblique but straight, the posterior angle thereby enlarged. Tegmina narrow, the apical half membranaceous and transparent. Inner wings with the basal half yellow. Hind femora slender, reaching tip of abdomen in female, much surpassing it in male.

Nine species of the genus occur in the United States, one of which has been taken in Indiana.

50. MESTOBREGMA CINCTUM (Thomas). The Ash-brown Locust.

Edipoda cincta Thom., 203, 1870, 80; Id., 204, II, 1871, 275; Id., 205, 1872, 464; Id., 206, V, 1873, 122; *Glov.*, 62, 1872, Plate XII, Fig. 13.

Mestobregma cinctum Thom., 211, IX, 1880, 90, 113; *Lugg.*, 84, 1898, 164, Fig. 99; *Scudd.*, 188, 1900, 39.

General color ash gray, or yellowish brown, spotted with fuscous. Face ash gray, with minute dark spots. Occiput and disk of pronotum darker, with often a yellowish line extending back from eye along the sides of the disk. Lateral lobes of pronotum with traces of alternate lengthwise bars of pale and fuscous, the former the narrower. Tegmina yellowish brown or grayish, often darker in the male, the lower field with two squarish dark spots separated by an oblong whitish spot; the apical half transparent, often with a few small dark spots along the costal margin. Inner wings with the basal third greenish or lemon yellow; a narrow curved fuscous band on middle third; the apical third smoky transparent, with a few fuscous dots near the tip. Outer face of hind femora ash gray or yellowish with three more or less distinct black spots on the upper margin.

Inner face black with two narrow yellow crossbars. Hind tibiae pale blue, sometimes dusky, with a whitish ring near the base, the spines black except at extreme base. Lower side of body yellow.

Measurements: Length of body, male, 18 mm., female, 25 mm.; of antennæ, male, 11.5, female, 12 mm.; of pronotum, male, 4.5 m., female, 6 mm.; of tegmina, male, 19 mm., female, 25 mm.; of hind femora, male, 11.5 mm., female, 14 mm.

This locust inhabits, as far as known, only the southern third of the State, having been taken in Crawford, Floyd, Lawrence and Jennings counties. It frequents old, abandoned fields, roadsides and bare places, especially those on high wooded slopes. On the hills about Wyandotte Cave, and the Knobs back of New Albany, it is especially common. The earliest date on which it has been taken was July 7, when it was found in numbers, and had doubtless been mature for some time. Both sexes fly actively

when flushed, the males making a low, whirring noise as they rise from the ground. The general range of *M. cinctum* is given as "Upper Mississippi Valley and Colorado." Thomas has recorded it from southern Illinois, and Garman from Bowling Green and Glasgow Junction, Kentucky.



Fig. 59. *Mestobregma cinctum* (Thos.). Male.
(After Lugger).

XXXIII. TRIMEROTROPIS Stal (1873).

Body of medium size; compressed. Head slightly exceeding the prozona in width, but always narrower than the metazona, which is considerably expanded. Vertex longer than broad, the lateral carinæ distinct, gradually converging, and continuous with the sides of the frontal costa; the median carina, if present, faint; the foveolæ small, but distinct and triangular. Frontal costa a little narrower just below the ocellus and at the point of union with the vertex; in our species with at least the lower two-thirds strongly sulcate. Antennæ, filiform. Pronotum with the disk nearly flat, either smooth or with minute tubercles on the metazona; the front margin truncate, the hind margin either acute, right or obtuse angled; the median carina, low, especially on the metazona; cut by two notches, the hindmost of which is much in advance of the middle; the lateral carinæ, rounded, indistinct. Lateral lobes of pronotum, with the front and hind margins nearly vertical, the lower margin with its front half directed upward, the posterior half arcuate, the angle well rounded. Teg-

mina much exceeding the abdomen in both sexes, in our species grayish or light brown in color, sprinkled with many small dark spots. Inner wings with the basal half light yellow; the apical third transparent; a narrow curved black band intervening. Hind femora of average width, reaching or exceeding the tip of abdomen in both sexes.

McNeill, in the latest monograph of this genus, describes and gives keys to 54 nominal species belonging to it. Of these, 49 are from the United States, 16 of which are confined to California; while but three occur east of the Mississippi River. Of these, two have been taken in Indiana.

KEY TO INDIANA SPECIES OF TRIMEROTROPIS.

- a.* Hind tibiæ yellow or greenish yellow; width of dark band of inner wing seldom more than one-sixth the length of wing.....
51 *maritima*, p. 281
- aa.* Hind tibiæ red; width of dark band of inner wing, broader, about one-fourth the length of wing.....52 *citrina*, p. 282

51. TRIMEROTROPIS MARITIMA (Harris). The Maritime Locust.

Locusta maritima Harr., 71, 1841, 143; Id., 72, 1862, 178.

Edipoda maritima Uhl., 213, 1862, 178; Glov., 62, 1872, Plate XII, Fig. 17; Thom., 206, V, 1873, 124.

Trimerotropis maritima Stal., 200, I, 1873, 135; Scudd., 148, 1874, 378; Id., 188, 1900, 42; Thom., 211, 1880, 113; Sauss., 134, 1884, 172; Fern., 53, 1888, 45; Bl., 11, XXVI, 1894, 218; Id., 15, XXX, 1898, 61; Bent., 3, VI, 1894, 299, Plate X, Fig. 5; Morse, 99, VIII, 1897, 37, 112, Plate 2, Fig. 29; Lugg., 84, 1898, 168, Figs. 101, 102; McN., 91, XXIII, 1901, 399, 410; Walk., 218, XXXIV, 1902, 2.

Size, medium. Pronotum with the median carina low throughout; the metazona about twice as long as the prozona, its disk flat, with a number of scattered minute rounded tubercles, the hind margin obtuse angulate. Inner wings twice as long as wide.

General color, light to dark gray or reddish brown mottled with brown or fuscous; the sides of head, lower parts of thorax and abdomen and the legs, often nearly white. Tegmina brownish yellow, sprinkled with fuscous dots, which are sometimes, especially in the darker male, arranged so as to form three irregular but distinct transverse bands; more often the spots are scattered along the sides, being most abundant on the basal third. Inner wings with disk light yellow; the width of curved black band rarely more than one-sixth the length of wing; the apex transparent. Inner face of hind femora pale yellow with three black bands; the lower sulcus pale with a black

spot near the apex; the outer face without distinct spots or bands. Hind tibiae obscure yellowish.

Measurements: Length of body, male, 21 mm., female, 28 mm.; of antennae, male, 10 mm., female, 11 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 24 mm., female, 28 mm.; of hind femora, male, 11.5 mm., female, 15 mm.

This species has been taken in Indiana only along the south shore of Lake Michigan, in Lake, Porter and Laporte counties, where it is common. It flies rapidly and noiselessly for long distances and, unless carefully marked down, is very difficult to detect. The darker specimens are always found at some distance from the lake, where there is a scattering vegetation; the light colored ones on the pure sand of the immediate shore. It has been seen nowhere more than a half mile back from the water margin, and then only on the bare crests of the highest sand ridges and dunes. The earliest date on which mature specimens have been taken was July 25th, and the latest October 15th, though they are doubtless to be found both before and after those dates. Its general range is given by McNeill as "Atlantic States from Virginia northward and along the shores of the Great Lakes west to Illinois."

52. *TRIMEROTROPIS CITRINA* Scudder.

Trimerotropis citrina Scudd., 147, II, 1876, 265; Id., 168, XXIII, 1893, 77; Id., 188, 1900, 41; Sauss., 134, 1884, 169; McN., IX, 1900, 31, 35; Id., 91, XXIII, 1901, 401, 426; Walk., 218, XXXIV, 1902, 1, 4.

Size, medium or large. Pronotum with the median carina very low; the metazona but little more than one and a half times as long as prozona; the disk flat, except on the prozona, where the sides are raised moderately, and smooth or nearly so; the hind margin decidedly obtuse angled, the tip rounded. Wings one and three-fourths times as long as broad.

General color ash gray or yellowish brown, sprinkled more or less with fuscous. The face usually light gray; the tegmina yellowish brown, the dark spots aggregated into three dark crossbars, indistinct in the female, plainly visible in the male. Wings pale lemon yellow at base, the fuscous band broad, the width being from one-fourth to one-fifth the length of wing; the sub-marginal ray short, extending less than half way to base. Inner face of hind femora yellow, with three fuscous bands; the lower sulcus yellow with a distinct sub-apical fuscous spot and traces of two others; the outer face plain yellowish brown or gray. Hind tibiae pinkish red, paler at base.

Measurements: Length of body, male, 22 mm., female, 30 mm.; of antennæ, male, 11 mm., female, 12 mm.; of pronotum, male, 5 mm., female, 6.5 mm.; of tegmina, male, 27 mm., female, 34 mm.; of hind femora, male, 13 mm., female, 15.5 mm.

This is a somewhat larger and more bulky insect than Indiana examples of *T. maritima*, the male being nearly as large as the female of the latter. In general appearance the two closely resemble one another and are apt to be confounded when they occur together.

I have taken this species in but one locality in Indiana. This was on a long sand and gravel bar, along the north shore of the Ohio River, a half mile below Vevay, Switzerland County. Here it was common on September 23, 1898, but having no net, I was able to capture but three specimens. Its flight along this gravelly bank was much less prolonged than that of *maritima* on the more extensive sand beach of Lake Michigan. When approached it would rise straight upward a few feet, and then move lazily and without noise eight to 15 feet, and alight again, always on the bare sand or gravel. The gravel bar was at the foot of a terrace 30 feet or more in height and a quarter of a mile wide, the surface of which was cultivated. No trace of *citrina* was found on this area, though other locusts were abundant. It has been recorded heretofore from Maryland, Arkansas, Texas, Colorado and Nebraska, and therefore is to be regarded as a southern form, which may be found all along the gravelly banks of the Ohio River.

XXXIV. PSINIDIA Stal (1813).

This genus is closely allied to *Mestobregma*, the general appearance of our species being very similar. Head with the occiput much elevated, the vertex much as in *Mestobregma*, but the lateral carinæ more nearly converging in front; the foveolæ smaller, sub-circular. Frontal costa sulcate throughout, the upper half very narrow, the lower half gradually expanding. Antennæ, especially those of the male, long; the joints of basal half strongly flattened, the edges higher than the center. Pronotum strongly constricted in the middle, the disk nearly smooth, the front margin truncate, the hind margin acute angled; the median carina sharp, straight and of equal height throughout, cut by two notches in front of the middle; the lateral carinæ rather sharp and distinct on the metazona; sub-distinct on the prozona. Lateral lobes of pronotum, with the front and hind margins as in *Mestobregma*, the lower margin with its front half arcuate, strongly directed upward. Tegmina narrowed, exceeding

the abdomen about one-fourth their length; their basal half densely coriaceous; many of the cells in the front half of the middle third two to four times as long as wide. Inner wings with the basal third usually orange red; otherwise as in *Mestobregma*, except that the black curved median band is broader. Hind femora reaching tip of abdomen in female, slightly exceeding it in male. Hind tibiae ringed with dusky and yellowish white.

One species of *Psinidia* occurs in the United States and Canada east of the Mississippi River.

53. *PSINIDIA FENESTRALIS* (Serville). The Long-horned Locust.

Edipoda fenestralis Serv., 196, 1839, 726; Thom., 206, V, 1873, 118.

Psinidia fenestralis Stal, 200, I, 1873, 133; Sauss., 134, 1884, 161; Fern., 53, 1888, 44; Beut., 3, VI, 1894, 303, Plate VIII, Fig. 3; Morse, 99, VIII, 1897, 37, 111, Plate 2, Fig. 28; Bl., 15, XXX, 1898, 56; Lugg., 84, 1898, 166, Fig. 100; Scudd., 188, 1900, 40.

Locusta eucerata Harr., 70, 1833, 583; Id., 72, 1862, 180.

Edipoda eucerata Scudd., 141, VII, 1862, 472; Glov., 62, 1872, Plate III, Figs. 1, 2; Plate V, Fig. 13; Plate VI, Fig. 23; Thom., 206, V, 1873, 119.

General color varying widely according to environment, from pale clay yellow to bright reddish brown or even blackish. Face yellowish brown, the cheeks grayish, the occiput and disk of pronotum darker. A narrow yellowish stripe extends back from eye on to disk of pronotum; the sides of latter with a fuscous bar near the middle. Teg-



Fig. 60. *Psinidia fenestralis* (Serv.). Male. One and one-half times natural size.
(After Lugg.)

mina yellowish or reddish brown, the lower half of sides with numerous small alternating light and dark spots; the upper half unspotted. Wings with the basal third usually orange or vermilion red, some-

times yellow; the middle third with a broad curved black band which reaches nearly to the anal angle; the front margin with a dusky bar reaching nearly to the base; the apical third pellucid. Outer face of hind femora reddish brown, with three dark, oblique bars on the upper half; inner face with alternating bands of black and yellow. Hind tibiæ whitish, with a dark ring at each end, and a broad one of the same color just above the middle; the apical halves of spines black.

Measurements: Length of body, male, 17 mm., female, 22 mm.; of antennæ, male, 12.3 mm., female, 11 mm.; of pronotum, male, 4.5 mm., female, 5.5 mm.; of tegmina, male, 19 mm., female, 21 mm.; of hind femora, male, 11.5 mm., female, 12.5 mm.

In Indiana the "long-horned locust" has been noted only in Lake Porter and Laporte counties in the sandy area bordering Lake Michigan, where it was first taken July 27, 1897. It is most common along the beach within one-half mile of the lake, in company with *Trimerotropis maritima* (Harris) and *Spharagemon wyomingianum* (Thom.), though a few specimens were taken on sandy ridges five miles from the lake shore. It has a quick, short flight, and always chooses a bare, sandy spot on which to alight. Unless it is carefully "marked down" it is then very difficult to distinguish, since its colors harmonize so perfectly with its surroundings. By keeping an eye on it, and stealthily approaching it can readily be taken by throwing the net quickly over it just as it is in the act of rising. The male makes a slight rattling sound as it flies, but the movement of the female is noiseless. The majority of the specimens taken had the inner wings a bright red at base, though variations in color, from light yellow to deep red, were frequent. It may possibly be found to occur on the sand covered areas throughout the northern third of Indiana, though it is probable that it is limited to the area immediately adjoining Lake Michigan.

Sub-family ACRIDINÆ.

The Indiana species of this sub-family may be easily recognized by the presence of a distinct spine or tubercle on the prosternum between the front pair of legs. They vary much in size and general appearance, and among them are found our most injurious insects of the order Orthoptera.

The head is, in general, smaller and less swollen than in the two preceding sub-families. The face (except in *Leptysma*) is rarely very oblique, often nearly perpendicular. The disk of vertex is never

sunken or concave, the lateral carinae being low and rounded, or often obsolete. The foveolæ are often wanting or indistinct. The disk of pronotum is always free from tubercles and prominent wrinkles; has its hind margin usually broadly rounded, and never acute angled; the median carina always low and of nearly equal height throughout; and the lateral carinae, with few exceptions rounded or obsolete. The tegmina are usually well developed, but in a number of species are very short, and in some extra-limital forms wholly wanting. The inner wings are never brightly colored as in the *Oedipodinae*, but are usually transparent.

The prevailing color of most species of the sub-family is dull olivaceous brown; though a number of them are so striped or mottled with yellow, green or fuscous as to be decidedly handsome. Among the members of the principal genus (*Melanoplus*) there is considerable variation in color locally, "according to the character of the station where found, and also seasonably, whether collected early or late in the fall. As a rule specimens collected after a number of hard frosts are duller, darker and more suffused than summer examples, the coloration of the individual being apparently considerably modified by such exposure."

With one or two exceptions, all of our species pass the winter in the egg stage, and begin to reach maturity about June 1st, though most of them are not common until July. The Kentucky blue-grass and the different kinds of meadow grasses are then a darker green and, when rank, turn brown early in the autumn. The different species of *Melanoplus* and other locusts whose hues are olive green or brown, find in the fallen clumps of these grasses places of hiding well suiting their color, as well as an abundance of food well suiting their taste.

The males of *Acridinae* rarely stridulate, and then only when at rest, by rubbing the inner surface of the hind femora against the outer surface of the tegmina.

Scudder, in his recent Catalogue of United States Orthoptera, lists 32 genera and 241 species as belonging to this sub-family. Of these, six genera and 26 species have been taken in Indiana. The genera may be distinguished by the following key:

KEY TO GENERA OF INDIANA ACRIDINÆ.

- a. Face very oblique. Head as long as or longer than the pronotum; the vertex being prolonged and more or less acuminate. Antennæ acuminate, the joints flattened.....XXXV. LEPTYSMA, p. 287
- aa. Face nearly vertical. Head shorter than the pronotum, the vertex advanced but little in front of the eyes. Antennæ filiform, the joints cylindrical.

- b. Size large, the length of tegmina of female 27 or more mm. Lobes of mesosternum longer than broad, the inner margin straight. Sub-genital plate of male with a distinct U or V-shaped notch on its upper side. .XXXVI. SCHISTOCERCA, p. 289
- bb. Size small or medium, the tegmina never over 25 mm. in length. Lobes of mesosternum transverse or equally long and broad, the inner margin usually rounded. Apex of sub-genital plate of male without a notch on its upper side.
- c. General color when living, a bright, pale green, with a conspicuous purple line along the top of pronotum and dorsal part of closed tegmina. Vertex at its narrowest point between the eyes less than one and one-half times the width of second joint of antennæ. Sub-genital plate of the male with a more or less distinct sub-apical tubercleXXXVII. HESPEROTETTIX, p. 297
- cc. Color usually dull, chiefly brownish or olivaceous. Vertex at its narrowest point between the eyes more than twice the width of second joint of antennæ. Sub-genital plate of male without a sub-apical tubercle.
- d. Dorsal surface of pronotum never twice as long as the average breadth, generally only half as long again; the sides more or less constricted in the middle. Antennæ of male, less than twice the length of pronotum. Sub-genital plate of male with the apex rounded.
- e. Head not large in proportion to pronotum, but little longer than the prozona. Pronotum not enlarged in front to receive the head. Cerci of male exceedingly variable, but very rarely styliformXXXVIII. MELANOPLUS, p. 298
- ee. Head swollen; large in proportion to the pronotum, nearly half as long again as the long prozona. Pronotum feebly flaring in front to receive the head. Cerci of male styliform.XXXIX. PHÆTALIOTES, p. 334
- dd. Dorsal surface of pronotum twice as long as average breadth; the sides parallel. Antennæ of male twice or more times as long as pronotum. Sub-genital plate of male broad, the apex truncate.XL. PAROXYA, p. 335

XXXV. LEPTYSMA Stal (1873).

Body slender, sub-cylindrical. Head as long as pronotum; the vertex prominent, projected in front of the eyes in the form of an equilateral triangle; the lateral carinæ low, the median carina wanting. Face very oblique, the frontal costa low, a little narrowed below the ocellus, shallowly sulcate throughout; eyes longer than wide, set very obliquely on the head. Antennæ shorter than head and

pronotum, tapering; the joints flattened. Pronotum almost cylindrical, the metazona a little the wider, the front margin truncate, the hind margin broadly rounded; the median carina very low; distinct only on the metazona; lateral carinæ obsolete. Lateral lobes of pronotum longer than wide; the front margin oblique, the hind margin concave, the lower margin sinuate. Prosternal spine short and rounded. Tegmina fully developed, the apical third gradually narrowed. Hind femora very slender, a little shorter than abdomen in both sexes. Cerci of male slender, tapering and bent abruptly upward and forward near the base. Sub-genital plate narrow, up-turned and tapering to a point. Upper valves of ovipositor much longer than lower ones, their upper margins with a row of prominent teeth.

But one species of the genus occurs in the United States.

54. *LEPTYSTMA MARGINICOLLIS* (Serville). The Slender-bodied Locust.

Opsomala marginicollis Serv., 196, 1839, 591.

Opomala marginicollis Thom., 206, V, 1873, 66, 196.

Leptystma marginicollis Stal., 200, 1873, 86; Comst., 41, 1888, 111, Fig. 102; Id., 42, 1895, 111, Fig. 123; Bl., 6, XXIV, 1892, 28; Id., 11, XXVI, 1894, 221; Id., 16, 1899, 241, Fig. 68; Scudd., 188, 1900, 47; Id., 190, IX, 1900, 116.

Ground color of living specimens light yellowish brown or fawn; unbroken except by a narrow, yellowish stripe, extending from the hind border of eye along the lower edge of pronotum to coxa of hind leg. In living specimens this line is bordered above by one of dark brown. When the insect is dried the brown and the tips of tegmina become darker.

Face, vertex, occiput and pronotum, densely punctured. Tegmina exceeding the abdomen by 3 to 5 mms. Wings transparent, equal to tegmina in male, slightly shorter in the female.



Fig. 61. *Leptystma marginicollis* (Serv.). (After Comstock).

Measurements: Length of body, male, 28 mm., female, 32 mm.; of antennæ, male, 8 mm., female 6 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 20 mm., female, 26; of hind femora, male, 14 mm., female, 17.5 mm.

This slender bodied, graceful species, has as yet been taken only in Vigo County, where, in October, 1892, it was found to be common on

the tall sedges and rushes which grew near the margin of a large pond in the Wabash River bottoms, nine miles below Terre Haute. Its range before that time had been supposed to be a strictly southern one, it having been recorded only from Florida and North Carolina. Since then it has been found to extend across the southern United States from the Atlantic to the Pacific. Its occurrence in numbers as far north as central Indiana is, therefore, of especial interest, and can only be accounted for by the presence of the broad and sheltering valley of the Wabash, within the confines of which it finds a climate and a vegetation congenial to its taste.

In 1893 and 1894 the insect was still present, though in rapidly decreasing numbers as the pond was partially drained. I was much surprised to find, on May 21, 1893, a fully developed male with soft flabby wings, as though just moulted, though no others of any age were seen on that date. In October, 1902, I again visited the former site of the pond, but found only a vast cornfield, with no signs of this or other rare *Orthoptera*, which formerly dwelt in numbers in that locality. If still a member of the Indiana fauna, *marginicollis* will probably be found only about the margins of the larger ponds in the lower Wabash Valley.

At the locality mentioned, *marginicollis* was never seen on the grass or ground and never hopped when disturbed, but moved with a quick and noiseless flight for 20 or more feet to a stem of sedge or rush, on which it alighted. The instant it grasped the stem, it dodged quickly around to the side opposite the intruder. Then holding the stem firmly with its short front and middle legs, it drew its slender hind femora close up against the body, and folding the tibiæ into position, hugged its support as closely as possible, and remained perfectly motionless. Its body is almost cylindrical, and being of the same general color as the stalk of the plant on which it rested, it was almost impossible to detect it, unless one saw exactly where it alighted. Eight times out of ten a person, by approaching quietly, could reach his hand about the plant stem and grasp the insect. Its habits excellently illustrated the so-called "protective mimicry" of form and coloring, as it always seemed to choose a cylindrical object, and one similar to its own color before alighting.

XXXVI. SCHISTOCERCA Stal (1873).

Locusts of large size. Vertex with the front sloping downward and passing insensibly into the frontal costa; the lateral carinæ low and indistinct, the median carina wanting, the foveolæ very small,

often obsolete. Face nearly vertical. Eyes oblong, oval, prominent. Antennæ of medium length, filiform. Disk of pronotum with the sides sloping on the prozona, the metazona usually flat or nearly so; the front margin truncate, the hind margin either broadly rounded or, in some males, obtuse angled; the median carina low but distinct, cut three times by the transverse sulci; the lateral carinæ wanting. Lobes of mesosternum longer than broad. Tegmina always fully developed. Inner wings of large expanse, transparent or nearly so. Hind femora slender, usually equaling or exceeding tip of abdomen. Hind tibiæ with smooth margins, and with numerous spines in regular rows on each side, but with no apical spine on the outer margin. Second tarsal joint only half as long as the first. Male with cerci oblong and of nearly equal breadth throughout; the sub-genital plate strongly upcurved, its apex deeply notched. Valves of ovipositor strongly exerted.

Eleven species of the genus occur in the United States. Of these, four have been taken in Indiana.

KEY TO INDIANA SPECIES OF SCHISTOCERCA.

- a. Antennæ of male not more than one-fourth longer than head and pronotum together.
 - b. Size very large. Tegmina of female much exceeding the abdomen. Disk of pronotum flat or nearly so, the median stripe broad55 *americana*, p. 290
 - bb. Size small. Tegmina of female but little if any exceeding the abdomen. Disk of pronotum with sides distinctly sloping, the median stripe confined to the carina.56 *damnifica*, p. 293
- aa. Size, medium. Antennæ of male one-third or more longer than the head and pronotum together.
 - c. General color yellowish brown or olive green; a distinct pale yellow mid-dorsal stripe on head, pronotum and closed tegmina57 *alutacca*, p. 294
 - cc. General color rusty brown. No yellow stripe on dorsal surface58 *rubiginosa*, p. 296

55. SCHISTOCERCA AMERICANA (Drury). The American Locust.

Gryllus americanus (Drury), 48, I, 1770, 128, Plate 49, Fig. 2.

Aceridium americanum Scudd., 141, VII, 1862, 466; Rathv., 109, 1862, 385, Fig. 25; Thom., 202, V, 1865, 448, 452; Id., 206, V, 1873, 172, Fig. 8; Id., 211, IX, 1880, 91, 129, Fig. 10; Glov., 62, 1872, Plate I, Fig. 15; Riley, 117, VIII, 1876, 103, Fig. 40; Id., 118, IX, 1877, 84, Fig. 17; Id., 214, I, 1878, 236, 448, Fig. 6; Id., 122, II, 1884, 194, Fig. 269; Comst., 41, 1888, 106, Fig. 96; Bent., 3, VI, 1894, 304, Plate IX, Fig. 3.

Aceridium (*Schistocerca*) *americanum* Stal, 200 I, 1873, 66.

Schistocerca americana Brun., 22, I, 1885, 136; Id., 28, XXVIII, 1893, 10, Fig. 1; Id., 30, 1893, 462, Fig. 106; Id., 31, 1894, 163, 204, Fig. 66; Id., 34, 1896, 122, Fig. 24; Id., 35, 1899, 133, Fig. 75; Id., 36, 1899, 270, Fig. 63; Bl., 4, XXIII, 1891, 79; Id., 9, VI, 1893, 465; Id., 16, 1899, 238, Fig. 63; How., 75, VII, 1895, 220, 429, Figs. 19-22; Weed, 222, 1897, 67, Figs. 21-25; Lugg., 84, 1898, 174, Figs. 105, 106; Morse, 100, VIII, 1898, 255, 271; Scudd., 184, XXXIV, 1899, 447, 474; Id., 188, 1900, 47.

Size large, the female often two inches or more in length. Vertex hexagonal, the disk a little depressed. Frontal costa prominent, sulcate in the middle below the ocellus; a little narrowed below point



Fig. 62. *Schistocerca americana* (Drury). Male. (After Luggér).

of union with the vertex. Antennæ but little, if any, longer than head and pronotum together. Disk of pronotum flat on metazona, the sides rounded and sloping on prozona, the surface marked with minute shallow cells, or densely punctate, the hind margin broadly rounded. Tegmina exceeding the abdomen one-fourth or more their length in both sexes. Hind femora slender, reaching tip of abdomen. Spine of prosternum large, curved somewhat backward. Notch of sub-genital plate of male narrow but deep.

Color, reddish brown, often with a slight vermilion tint. A yellow stripe extends from the vertex along the middle of head, pronotum and closed tegmina as far as the tip of the abdomen. A dark brown line runs from the lower side of eye down the cheek. Sides of pronotum with a broad yellowish stripe on upper third and a short and narrow yellow dash near the center; the lower margin yellowish. Tegmina with numerous large dark brown spots, separated by light interspaces; the costal or lower margin whitish yellow, mottled with darker. Wings transparent, the nerves of basal portion yellowish. Outer face of hind femora reddish brown, with one or two dark streaks along the upper third. Hind tibiæ vermilion red, duller in dried specimens; the spines yellow, tipped with black.

Measurements: Length of body, male, 42 mm., female, 50 mm.; of antennæ, male, 13 mm., female, 14 mm.; of pronotum, male, 9 mm., female, 11 mm.; of tegmina, male, 43 mm., female, 53 mm.; of hind femora, male, 24 mm., female, 30 mm.

This is the largest locust found in the State, and when freshly moulted, one of the most handsome. It probably occurs in all the counties but is much less common in the northern half, though I have taken it in Fulton, Starke, Lake and Porter. Freshly moulted, mature specimens, from eggs hatched in spring, have been taken in Vigo County on June 18th, and on three different occasions numerous specimens have been seen as late as November 22d. On this date, in Marion County, when the government thermometer registered 17° in the morning, several were flushed in the afternoon, though a cold raw wind was blowing. In central and southern Indiana it is more abundant in mid-autumn than in summer. There occasionally may be two broods in one season, as I have found the nymphs common in Vigo County on October 15th and 21st.

This species is noted for its extended migrations and when a second brood appears, they are doubtless from eggs laid by mature specimens which have entered the State in early spring. About 3 o'clock in the morning of April 11, 1893, the city of Terre Haute, Indiana, was visited with a severe storm of rain and wind from the southwest. A number of buildings were unroofed and many shade and forest trees twisted and broken off. While on my way to the High School building several persons informed me that they had, that morning, seen specimens of "gigantic grasshoppers" on the street, but were unable to capture them. About 10 o'clock one of my former pupils brought me two living specimens of *S. americana* which she had picked up from the sidewalk near her home. They had come sailing in on the wings of the wind from some distant point in the southwest, where they had passed the winter in the mature state or as an advanced form of the young. Mature individuals which had doubtless migrated have also been taken in Lake County on May 13th.*

In the southern portion of Indiana, *americana* is always found in dry, upland localities, such as the borders of roads, old meadows, weed and stubble fields, prairies, and especially in old abandoned fields which have grown up to oak and other shrubs. In the northern portion it occurs in damper localities, being found in the tall grasses and sedges along the borders of sloughs and marshes and in the meadows bordering lakes and tamarack marshes. When flushed it rises quickly and with a fluttering noise, makes a long, wavering, jerky flight, and alights upon the bole or branch of tree or shrub, a fence, or some other object some distance above the earth; seldom,

*At Ormond, Florida, this locust was abundant and mature in early March, 1899, and it may pass the winter in the mature stage in some of the States much farther north.

if ever, settling on the ground. If then approached, it dodges around the object upon which it rests, much as does a squirrel under the same circumstances.

Of the distribution of the American locust Scudder has written: "Excepting *S. peregrina*, which has crossed the ocean and colonized another world, *S. americana* is the most widely distributed member of the genus, and merits its name, ranging as it does from North America east of the Great Plains and south to about latitude 40°; through the West Indies, Mexico and Central America to South America, where it occurs as far as Columbia in the west and Argentina in the east, though the records of its occurrence in South America are few. North of north latitude 40° or thereabouts, sporadic cases of its appearance are recorded, notably in Massachusetts and southern Ontario; these are doubtless accidental visitants, flying from their proper home farther south."

56. *SCHISTOCERCA DAMNIFICA* (Saussure).

Acridium damnificum Sauss., 128, II, 1861, 14.

Schistocerca damnifica Scudd., 184, XXXIV, 447, 475; Id., 188, 1900, 47; Bl., 18, 1902, 48, 222.

Cyrtacanthacris unilineata Walk., 219, IV, 1870, 611.

Acridium unilineatum Thom., 188, V, 1873, 170.

Acridium appendiculatum Scudd., 162, XIX, 1877, 86; Id., 161, VI, 1878, 27.

Acridium rubiginosum Thom., 206, V, 1873, 170; Id., 211, IX, 1880, 91, 128 (not Harris).

Size of male small; of the females medium and more bulky. Head small; the disk of vertex hexagonal. Frontal costa sulcate, and with the sides parallel below the ocellus, a little expanded and flat just above, then narrowed at point of union with vertex. Antennæ of male stout, but little, if any, longer than head and pronotum together. Disk of pronotum with the surface very rough with small pits and impressions, the sides strongly sloping, the median carina relatively high, and a little arched, the hind margin right angled in the male, obtuse angled in the female. Tegmina of male usually equaling or slightly exceeding the abdomen; those of female a little shorter; broader than in *alutacea*. Hind femora of female shorter than abdomen. Notch of sub-genital plate of male deep and narrowly V-shaped.

Color, a nearly uniform dark rust red. A narrow brownish yellow line on occiput and carina of pronotum. Tegmina often with small, dim dusky spots. Outer face of hind femora sometimes whitish, with dark narrow oblique lines arranged herring-bone fashion.

Measurements: Length of body, male, 25 mm., female, 42 mm.; of antennæ, male, 10 mm., female, 11 mm.; of pronotum, male, 7 mm., female, 9.5 mm.; of tegmina, male, 22 mm., female, 27 mm.; of hind femora, male, 16 mm., female, 19 mm.

This is a locust of southern range, which in Indiana has been taken only in Crawford County. A single female was secured May 10, 1899. This was probably a migrant, as this is a very early date for eggs hatched in spring to mature, and it is not known that the species winters in the nymph stage. Other specimens were taken in June and July, 1902. It frequents old fields and roadsides on the crests of the higher hills near Wyandotte, and is probably to be found in similar localities in the southern third of the State. When flushed they fly long distances and often alight on the limbs of trees or fence posts, around which they dodge, and from which they may often be taken with the hand.

Thomas has taken *damnifica* in southern Illinois, and Scudder says that it "is a common southern species, occurring in the United States east of the Great Plains, from Pennsylvania, Indiana, Illinois and Arkansas to the Gulf." He gives no Indiana locality. In 1899 I found it abundant at Ormond, Florida, on March 11th and later.

57. *SCHISTOCERCA ALUTACEA* (Harris). The Leather-colored Locust.

Acridium alutaceum Harr., 71, 1841, 139; Id., 72, 1862, 173; Scudd., 141, VII, 1862, 466; Rathv., 109, 1862, 384, Fig. 25; Glov., 62, 1872, Plate VIII, Fig. 13; Plate X, Fig. 13; Thom., 206, V, 1873, 171; Comst., 41, I, 1888, 106; Fern., 53, 1888, 30; Bl., 4, XXIII, 1891, 79; Beut., 3, VI, 1894, 304, Plate IX, Fig. 2.

Schistocerca alutacea Brun., 29, III, 1893, 26; Lugg., 84, 1898, 172; Morse, 100, VIII, 1898, 255, 270, Plate 7, Fig. 32; Scudd., 184, XXXIV, 1899, 445, 464; Id., 188, 1900, 47.

Acridium emarginatum Dodge, 44, IV, 1872, 15; Scudd., 147, 1872, 250; Thom., 206, V, 1873, 172; Id., 211, IX, 1880, 91, 128.

Schistocerca unmarginata Brun., 29, III, 1893, 26; Id., 33, II, 1895, 7, Fig. 46; Lugg., 84, 1898, 173, Fig. 104.

Size medium, the female much the larger, with more robust body. Vertex rather prominent, narrow, the disk sub-rhomboidal, but little depressed, the lateral carinæ low, distinct only on front half. Frontal costa narrow, sulcate below the ocellus. Antennæ of male one and a half times as long as head and pronotum together, the joints a little flattened. Disk of pronotum flat on metazona, the sides higher and sloping on prozona, the hind margin broadly obtuse angled; the surface densely punctate; the median carina low but distinct. Prosternal spine large, cylindrical, the apex rounded.

Tegmina exceeding the abdomen about one-fourth their length in both sexes. Hind femora slender, reaching the tip of abdomen in female, exceeding it slightly in male. Cerci of male short oblong, the upper edge concave or broadly notched; the notch of sub-genital plate U-shaped, about as broad as deep.

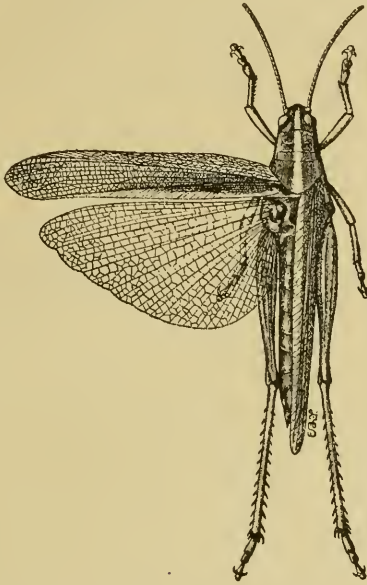


Fig. 63. *Schistocerca alutacea* Harris. Female. (After Lugger.)

Color, yellowish brown to olive green, darker in old or dried specimens. A narrow bright yellow line runs from the front of vertex back over head, pronotum and middle of closed tegmina. Sides of tegmina with often a few minute fuscous spots. Wings transparent yellowish, the veins darker. Sides of abdomen with a row of black dots on the hind margin of each segment. Outer face of hind femora reddish brown or yellowish with a row of black dots along the upper and lower margins. Hind tibiae reddish; the spines yellowish, tipped with black.

Measurements: Length of body, male, 30 mm., female, 45 mm.; of antennæ, male and female, 16 mm.; of pronotum, male, 7 mm., female, 10 mm.; of tegmina, male, 26 mm., female, 38 mm.; of hind femora, male, 18 mm., female, 25 mm.

This species has been taken only in the western half of the State from Monroe County northward. It is abundant about the marshy meadows and sloughs in Fulton, Lake and Starke counties, where it

has been taken on August 15th in numbers. There it makes its home in the rank grasses, weeds and rushes which grow in such places. The males are everywhere much more abundant and more active than the females, though they usually fly a shorter distance. In Vigo County it is frequent in patches of raw prairie and along the edges of thickets bordering them; also in many places along the railways, especially where they pass through prairie regions. Both sexes, when flushed, arise with a whirring noise which, however, is not a true stridulation. The males usually fly about 50 feet and settle down on the grass or on a low shrub. This locust will doubtless be found to inhabit suitable localities throughout the State, as it has been taken from New England to California.

58. *SCHISTOCERCA RUBIGINOSA* (Harris-Scudder). The Rusty Locust.

Acridium rubiginosum Scudd., 141, VII, 1862, 467; *Glov.*, 62, 1872, Plate V, Fig. 5; Riley, 122, II, 1884; 194; *Comst.*, 41, 1888, 106; *Fern.*, 53, 1888, 30; *Beut.*, 3, VI, 1894, 304, Plate IX, Fig. 1.

Schistocerca rubiginosa Morse, 93, VII, 1894, 105; *Id.*, 100, VIII, 255, 269, Plate 7, Fig. 31; Scudd., 184, XXXIV, 1899, 445, 462; *Id.*, 188, 1900, 48.

Schistocerca alutacea Rehn., 111, XIII, 1902, 89; *Id.*, 112, 312.

Size, medium; the body of the female especially bulky. Head and pronotum wider than in *alutacea*, but the vertex less prominent. Frontal costa wider and flatter than in *alutacea*, sulcate below the ocellus. Antennæ of male a third longer than head and pronotum together. Pronotum with the sides sloping on both prozona and metazona; the median carina more prominent than in *alutacea*, otherwise the same. Tegmina exceeding the abdomen in both sexes. Notch at apex of cerci of male less evident than in preceding species; that of sub-genital plate narrower, more V-shaped.

Color a nearly uniform rusty brown, without median yellow stripe on head and pronotum; the tegmina usually with numerous dim, rounded fuscous spots on the sides. Wings transparent and glassy, slightly reddish toward the tip.

Measurements: Length of body, male, 30 mm., female, 43 mm.; of antennæ, male, 13 mm., female, 15 mm.; of pronotum, male, 7 mm., female, 10 mm.; of tegmina, male, 27 mm., female, 37 mm.; of hind femora, male, 17 mm., female, 22 mm.

This seems to be a scarce locust in Indiana, having been taken only in Porter County. It prefers dry upland pastures and woodland, especially those with a soil of sand, where scrub oaks abound. Its habits are the same as those of *alutacea*. Rehn, *loc. cit.* has placed

it as a synonym of that species; but, aside from the color, the shorter antennæ, less prominent vertex and frontal costa, and more sloping disk of pronotum are sufficient to show its distinctness. The mere fact that on one or two occasions, opposite sexes of it and *alutacea* were found in copulation is no proof of their identity in species, for such widely diversified forms as *Melanoplus bivittatus* and *Melanoplus differentialis* have been noted thus. *Rubiginosa* ranges over the United States east of the Great Plains and will doubtless be found to inhabit dry sandy localities in many portions of the State.

XXXVII. HESPEROTETTIX Scudder (1876).

Size small; the sides nearly parallel; not greatly compressed. Head small, the vertex opposite the middle of eyes but little wider than second joint of antennæ; the portion in front with a slight median furrow or depression. Face but little oblique, the frontal costa narrow, sulcate throughout, punctate. Antennæ of female equaling the head and pronotum together; a fourth longer in the male. Pronotum longer than in allied genera except *Paroxya*, the prozona half as long again as metazona, the sides of disk broadly sloping; the median carina low, not cut by the first and second sulci; the hind margin very obtusely angulate. Lateral lobes of pronotum with the front and hind margins nearly straight, oblique; the lower margin with its front half directed upward. Tegmina usually equaling or slightly exceeding the tip of abdomen. Fore and middle femora of male swollen; hind femora slender, much surpassing the abdomen. Subgenital plate of male entire, but with a more or less distinct sub-apical tubercle.

Seven nominal species are known from the United States, mostly from west of the Mississippi River. One has been taken sparingly in northern Indiana.

59. HESPEROTETTIX PRATENSIS Scudder.

Hesperotettix pratensis Scudd., 181, 1897, 57, 64, Plate V, Fig. 3; Id., 188, 1900, 50; Lugg., 84, 1898, 177, Fig. 107; Brun., 36, 1899, 247, 271.

Ommatolampis viridis Thom., 206, V, 1873, 156 (in part).

Pronotum slightly increasing in size from in front backward. Tegmina equaling or slightly exceeding the abdomen in both sexes. Supra-anal plate of male triangular, the middle of either half with a distinct ridge, which converge and enclose a basal groove, in which lie the minute, rounded furcula. Cerci, shorter than supra-anal

plate, conical, tapering to a rather sharp point. Tubercle on subgenital plate indistinct. (See Fig. 1, Plate I.)

Color, bright pale green. A short fuscous bar below each eye and on middle of sides of pronotum; also one along middle of occiput.



Fig. 64. *Hesperotettix pratensis* Scudd. Female. Natural size. (After Lugger).

Antennae pinkish. Disk of pronotum with a pinkish or purplish stripe along its middle, extending back along median line of closed tegmina, and fading insensibly into the green of their sides. Hind femora green, more or less tinged

with purplish. Hind tibiae, pale bluish green; the spines whitish, tipped with black. Abdomen greenish yellow.

Measurements: Length of body, male, 17 mm., female, 24 mm.; of antennae, male, 8 mm., female, 9 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 12 mm., female, 17 mm.; of hind femora, male, 11 mm., female, 13.5 mm.

This dainty and prettily colored species has been noted only in Lake County, where it has been taken in two localities. On September 19, 1898, a single pair were secured from the long grasses bordering the margin of a swale north of Millers. Though careful search was made there and elsewhere in the northern counties, no others were secured until July 24, 1902, when I found them rather common in a long, low, marshy tract, a mile southeast of Hammond. Here the males were especially active, leaping from one grass stem to another several times in succession, and dodging around the stem the instant they clasped it with their legs. The females were oftentimes easily picked up by the fingers from their resting places. No attempt was made by either sex to use the wings in escaping.

Pratensis ranges, according to Scudder, from the "Mississippi River westward to California;" though he also names southern Illinois as one of its localities. It should be looked for along the edges of prairies and marshes throughout the western half of Indiana.

XXXVIII. MELANOPLUS Stal (1873).

Body moderately stout; generally feebly compressed. Head not prominent,* but little if any longer than the prozona. Face almost vertical. Vertex between the eyes but little wider than the frontal costa; the front half sloping downward, and always more or less sulcate, especially in the male. Frontal costa of average width and

* Except in *punctulatus*.

prominence, usually sulcate below the ocellus. Antennæ slender, filiform, never more than twice as long as the pronotum. Disk of pronotum usually only half as long again as the average breadth; the prozona distinctly longer than the metazona, its edges parallel, its surface a little convex and faintly punctate; metazona with its edges more or less diverging backward, its surface flat and densely punctate; front margin truncate, hind margin obtuse angulate; the median carina low but distinct on the metazona, often faint or obsolete on the prozona; the lateral carinæ obsolete. Lateral lobes of pronotum vertical or nearly so, and usually marked on their upper half with a blackish band. Tegmina always present, in some species being mere oval or lanceolate scales, but little, if any, longer than the pronotum; in others fully developed and then attaining or a little surpassing the tips of the hind femora.* Wings either represented by minute scales or fully developed, transparent, colorless. Hind femora moderately long and slender, usually equaling the tip of abdomen in the female and surpassing it in the male. Cerci of male exceedingly variable in form, often enlarged at apex, never styliform, and usually about the length of the sub-genital plate. Furcula usually developed and to a variable extent and also variable in form; so that they and the cerci furnish characters much used in separating the species one from another.

This genus comprises more species than does any other of the North American Orthoptera, no less than 146 being listed by Seuder from the United States and Canada. Of these 17 have been taken in Indiana. Some of these, to the casual observer, may seem very similar in size, color and general appearance, but a close examination of the abdominal appendages of the male will at once prove their distinctness. The tyro will probably have much difficulty in separating the females of the different species; in fact, he can only do so by taking the two sexes in the field, where they are usually to be found associated together. While dull colored and uninteresting to most people, the members of this genus form the most characteristic group of our Acrididæ. To it belong our most common locusts and the ones which do the most injury. From mid-May until late November they leap from our pathway in numbers, whether we stroll through open woodland, sunny meadow, or along the roadside; while in the back yards and on the lawns of our city homes they swarm in great profusion.

*None of our species, unless it be *fasciatus*, are dimorphic as regards wing length. I have seen only the short winged form of *fasciatus*, in Indiana, though a long winged one is known.

The Kansas or Rocky Mountain grasshopper, *Melanoplus spretus* (Uhler), belongs to this genus, but does not occur in Indiana. Contrary to the general belief, it is not a large, robust species, being but about the same size as our red-legged grasshopper, *M. femur-rubrum* (DeG.), and bearing to the latter a close general resemblance; so



Fig. 64½. *Melanoplus spretus* (Uhler).
Male. Natural size.

close, in fact, that only specialists can readily tell them apart. Millions of dollars of damage was done in the Western States by these small insects in the summers of 1873 and 1875. Migrating in vast clouds from

one part of the country to another they would fall upon a corn-field and convert, in a few hours, the green and promising acres into a desolate stretch of bare, spindling stalks and stubs. In the words of the prophet Joel: "The land was as the garden of Eden before them, and behind them a desolate wilderness; yea, and nothing did escape them."

The following key will aid in the separation of the 17 Indiana species of the genus:

KEY TO THE INDIANA SPECIES OF MELANOPLUS.

- a. Tegmina much shorter than the abdomen; often no longer than the pronotum. Furcula of male almost always feebly developed, usually no longer than the last dorsal segment to which they are joined.
 - b. Cerci of male either equal or tapering beyond the middle, no broader at apex than at the middle, usually laminate. Tegmina ovate, about the length of the pronotum.
 - c. Lateral lobe of pronotum a uniform wood brown in the female; with a faint dusky bar on upper half in male. Hind femora of male not barred with blackish. Hind tibiae red 60 *scudderi*, p. 302
 - cc. Lateral lobe of pronotum in both sexes with a broad shining black bar along the upper half; the lower half yellowish white. Hind femora of male with two distinct oblique blackish bars. Hind tibiae pale green. 61 *viridipes*, p. 305
 - bb. Cerci of male with the apex more or less expanded, broader at obovate or narrowly oblong, or longer than pronotum and lanceolate.
 - d. Tegmina shorter than pronotum, and with a wide interval between their inner edges.
 - e. Hind margin of pronotum without a trace of median notch. Cerci of male truncate at tip. Furcula cylindrical, tapering 62 *obovatifemnis*, p. 306

- ce. Hind margin of pronotum with a minute but distinct notch in the middle. Cerci of male rounded at tip. Furcula not cylindrical or tapering.
- f. Tegmina narrowly oblong. All the femora green. Furcula minute, rounded.....
63 *gracilis*, p. 308
- ff. Tegmina broadly ovate. All the femora brown. Furcula well developed, very broad at base, more or less angled or bifid at middle64 *morsei*, p. 309
- dd. Tegmina lanceolate, longer than pronotum, their inner edges overlapping.
 - g. Subgenital plate of male distinctly narrower than long, its extremity strongly elevated. Middle of male cerci but little narrower than base. Tegmina covering two-thirds or more of abdomen
65 *fasciatus*, p. 311
 - gg. Sub-genital plate of male short and broad, its extremity but little elevated. Middle of male cerci distinctly narrower than the base. Tegmina covering but one-half the abdomen66 *blatchleyi*, p. 313
- aa. Tegmina (except in the female of *extremus*) as long as or longer than the abdomen. Furcula usually either well developed or obsolete.
- h. Cerci of male either equal or tapering beyond the middle, the tip usually slender or acuminate, never forked.
 - i. Apex of sub-genital plate of male with a median notch. Cerci short and nearly equally broad throughout, their length not more than twice as much as the middle breadth67 *atlantis*, p. 314
 - ii. Apex of sub-genital plate of male entire. Cerci at least three times as long as the middle breadth, generally slender, the apical half sometimes much narrower than the basal.
 - j. Sub-genital plate of the male nearly as broad at apex as at base; the apex elevated above the lateral margins, and terminating in a tubercle. Cerci of male narrowing but little in apical half.....
68 *impudicus*, p. 316
 - jj. Sub-genital plate of male distinctly narrower at apex than at base, the apex not elevated above the lateral margins. Apical half of cerci distinctly narrower than the basal half.
 - k. Tegmina much surpassing the hind femora; hind tibiae bright red. Apical half of male cerci much less than half as broad as the extreme base69 *femur-rubrum*, p. 317

- kk.* Tegmina shorter than hind femora; those of female shorter than abdomen. Hind tibiae pale red or yellowish. Apical half of male cerci distinctly more than half as broad as the extreme base70 *extremus*, p. 319
- hh.* Cerci of male with the apex more or less expanded so as to be broader at some point beyond the middle than at the middle; the tip spatulate or sub-spatulate or forked.
- l.* Cerci of male not forked, the tip no broader than the base. Furcula well developed, at least a third as long as supra-anal plate71 *angustipennis*, p. 321
- ll.* Cerci of male either distinctly forked or with a sub-median process or angle; or else expanded so as to be very much broader at the tip than at the base. Furcula wanting or minute.
- m.* Size small, the male being less than 20 mm. in length. Cerci always forked or with a sub-median angulation:
- n.* Lower fork of cerci merely an angle or median process. Furcula consisting of slender spines. Bases of lateral margins of sub-genital plate incurved72 *minor*, p. 322
- nn.* Forks of cerci nearly equal, distinct. Furcula consisting of short triangular lobes. Lateral margins of sub-genital plate nowhere incurved73 *luridus*, p. 324
- mm.* Size larger, the length of male being more than 20 mm. Cerci with the apical half much enlarged, but never distinctly forked.
- o.* Tegmina without distinct roundish fuscous spots. Length of body of male more than 25 mm. Front margin of pronotum not flaring to receive the head.
- p.* Pronotum without light colored lateral stripes. Hind tibiae yellow. Furcula of male wholly absent.....74 *differentialis*, p. 326
- pp.* Pronotum with light colored lateral stripes along the margin of the disk. Hind tibiae red or purplish. Furcula present but small75 *bivittatus*, p. 329
- oo.* Tegmina with distinct roundish fuscous spots. Length of body of male less than 23 mm. Front margin of pronotum slightly flaring to receive the prominent head.....76 *punctulatus*, p. 331

60. MELANOPLUS SCUDDERI (Uhler). Scudder's Short-winged Locust.
Pezotettix scudderi Uhl., 212, II, 1864, 555; Thom., 206, V, 1873, 152;
 Id., 211, IX, 1880, 95, 121; Comst., 41, 1888, 107; Bl., 4,
 XXIII, 1891, 80; Bent., 3, VI, 1894, 309, Plate VIII, Fig. 6.

Melanoplus scudderi Scudd., 179, XXXVI, 1897, pp. 8, 33; Id., 181, 1897, 125, 212, Plate 14, Figs. 5, 6; Id., 188, 1900, 63; Lugg., 84, 1898, 184, Fig., 108; Morse, 100, VIII, 1898, 256, 280, Plate 7, Fig. 37.

Pezotettix unicolor Thom., 206, V, 1873, 151; Id., 208, V, 1875, 888, Plate XLV, Fig. 4; Id., 211, IX, 1880, 95, 118; Glov., 62, 1873, Plate XIII, Fig. 9.

Size medium or small. Vertex but little elevated above the pronotum, the interspace between the eyes of the female, about as broad as frontal costa, narrower in the male; its front half strongly sloping downward; the median sulcus shallow. Frontal costa feebly sulcate at and below the ocellus. Antennæ about three-fourths (male) or less than two-thirds (female) as long as hind femora. Pronotum with the disk broadly convex; the prozona from a fourth to a half longer than the densely punctate metazona, the median carina distinct, but low and equal throughout; front margin truncate or nearly so, and often faintly notched in the middle; hind margin obtuse-angled. Tegmina about as long as the pronotum, broad ovate in shape, their inner edges a little separated or just touching in the male, often overlapping in the female. Wings not half the length of the tegmina. Cerci of male sub-falcate, about twice as long as their basal breadth; the rounded apex about half as broad as the base. Furcula minute, triangular. (See Fig. 2, Plate I.)

Color: Dull reddish or wood brown, nearly uniform in the female. The male, and sometimes the female, with an indistinct dusky bar reaching from the eye back along the upper half of each lateral lobe of pronotum as far as the metazona. Hind femora with two faint dark bars on their upper face, the knees blackish. Hind tibiae bright red, often paler at base, the spines black.

Measurements: Length of body, male, 19 mm., female, 24 mm.; of antennæ, male and female, 8 mm.; of pronotum, male, 6 mm., female, 7 mm.; of tegmina, male, 6 mm., female 7 mm.; of hind femora, male, 11 mm., female, 13 mm.

This short-winged, dull colored locust occurs throughout the State, but is more common southward. On account of its short tegmina, persons who are interested in Orthoptera are very apt at first to regard it as a nymph of some other species. In the central counties it begins to reach maturity about August 5th, and has been taken as late as November 22d. It is one of the most common of the late autumn locusts, frequenting the borders of open woods, fence rows and roadsides, especially in dry situations where blue-grass abounds. On warm sunny afternoons in November, it may often be seen resting quietly on the sides of logs, or the lower part of rail or board fences,

EXPLANATION OF PLATES I AND II

PLATE I.

- Fig. 1. *Hesperotettix pratensis* Scudder.
2. *Melanoplus scudderi* (Uhler).
3. *Melanoplus viridipes* (Walsh).
4. *Melanoplus obovatipennis* (Bl.).
5. *Melanoplus gracilis* (Brun.).
6. *Melanoplus morsci* Bl.
7. *Melanoplus fasciatus* (Walker).
8. *Melanoplus blatchleyi* Scudd.
9. *Melanoplus atlantis* (Riley).
10. *Melanoplus impudicus* Scudder.

PLATE II.

- Fig. 11. *Melanoplus femur-rubrum* (DeG.).
12. *Melanoplus extremus* (Walker).
13. *Melanoplus angustipennis* (Dodge).
14. *Melanoplus minor* (Scudder).
15. *Melanoplus luridus* (Dodge).
16. *Melanoplus differentialis* (Uhler).
17. *Melanoplus bivitatus* (Say).
18. *Melanoplus punctulatus* (Uhler).
19. *Phetaliotes nebrascensis* (Thom.).
20. *Paroxya hoosieri* (Bl.).

PLATE I.



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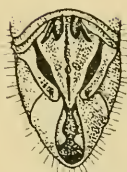
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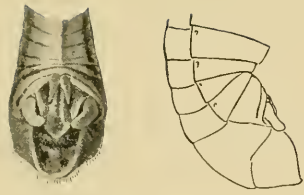


MALE ABDOMINAL APPENDAGES OF HESPEROTETTIX AND MELANOPLUS.

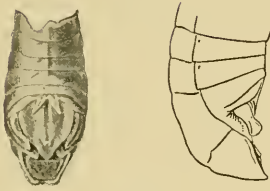
PLATE II.



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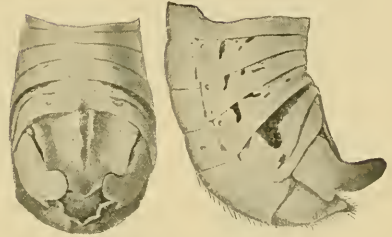
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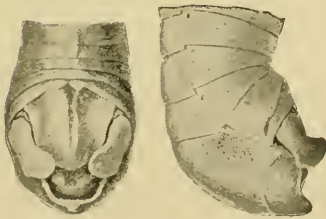
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and apparently enjoying the sunshine. It is able to withstand quite severe frosts and has been seen in copulation as late as November 15th. The general range of *scudderi* is over the United States east of the Great Plains.

61. **MELANOPLUS VIRIDIPES** (Walsh-Scudder). The Green-legged Locust.
Pezotettix viridipes Walsh, MS, 1865; Bl., 4, XXIII, 1891, 80; Id., 6, XXIV, 1892, 34.
Melanoplus viridipes Scudd., 179, XXXVI, 1897, 13, 33; Id., 181, 1897, 128, 255, Plate 17, Fig. 4; Id., 188, 1900, 65.
Pezotettix viridulus McN., 88, VI, 1891, 75; Bl., 6, XXIV, 1892, 34; Id., 11, XXVI, 1894, 245.

Size, medium. Vertex moderately swollen, but little elevated above the pronotum, the portion between the eyes, half as broad again (male) or twice as broad (female) as the basal joint of antennæ; the front half sloping downward and distinctly sulcate, especially in the male. Frontal costa narrowed slightly above the ocellus, shallowly sulcate in the male. Antennæ of male equaling or slightly exceeding the hind femora in length; those of female relatively shorter. Pronotum with the disk faintly expanding on posterior half, the median carina distinct on metazona, less so on prozona; the hind margin broadly rounded; prozona about half as long again as the densely punctate metazona. Tegmina equaling (female) or a little longer (male) than the pronotum, elliptical, the apex rounded, the inner edges slightly overlapping in the male, often a little separated in the female. Extremity of male abdomen much recurved; the cerci long and rather slender, erect and a little incurved, tapering gradually from base to apex. Furcula consisting of a pair of minute, widely separated, triangular lobes. Apex of sub-genital plate elevated and terminating in a conical tubercle. (See Fig. 3, Plate I.)

Color, brownish fuscous above, yellowish brown below. Occiput of male darker. A broad, shining black band extends backward from the eye along the upper half of lateral lobe of pronotum, and is bordered below by an ivory white or yellowish band. Disk of pronotum and tegmina wood brown. Fore and middle femora greenish; hind femora yellowish brown, with two oblique dark bars on outer face, more distinct in male. Hind tibiae pale green, the spines black.

Measurements: Length of body, male, 18 mm., female, 23 mm.; of antennæ, male, 9.5 mm., female, 8.5 mm.; of pronotum, male,



Fig. 65. *Melanoplus viridipes* (Walsh). Male. One and one-third times natural size. (Original).

5 mm., female, 6 mm.; of tegmina, male and female, 6 mm.; of hind femora, male, 9.5 mm., female, 12 mm.

This handsome, short-winged form seems to be rather limited in distribution, having been noted only at two or three points in Illinois and in Posey, Monroe, Vigo, Marion and Lake counties, Indiana. With us, it is the first locust to reach maturity from eggs hatched in spring, a mature male having been taken in Vigo County on May 11th, and a number of both sexes in Posey County on May 12th. By June 1st it is common locally, and by August 1st has mostly disappeared. It frequents rather low, flat woods and clearings, being found about the margins of burned or bare places.

On June 3, 1900, I happened upon a large colony of *viridipes* in the upland woods just west of the State Fair Grounds, in Marion County. They were in an open, rather bare tract near the center of the woods, which was surrounded by beech and black maple trees. I took with the fingers, 40 of them in 20 minutes, and could have secured as many more. The males, when first disturbed, would leap two or three feet, almost perpendicularly, for several times in rapid succession, then give one or two sidewise leaps, and if still pursued, endeavor to hide the head beneath a dead leaf. The females were more clumsy, and after giving one or two short leaps would squat close to the ground, when they were readily taken. One pair were mating and a number were yet in the nymph stage. On June 1, 1902, I found the species abundant in the same place. In Lake County it was taken in a similar woods just back of the hotel on the west side of Cedar Lake. McNeill says that in Illinois "it shows a decided preference for open grassy ravines." It probably occurs in suitable localities over the greater portion of Indiana.

62. *MELANOPLUS OBOVATIPENNIS* (Blatchley). The Obovate-winged Locust.

Pezotettix obovatipennis Bl., 11, XXVI, 1894, 241.

Melanoplus obovatipennis Scudd., 179, XXXVI, 1897, 14, 34; Id., 181, 1897, 129, 264, Plate 17, Fig. 10; Id., 188, 1900, 61; Bl., 15, XXX, 1898, 62.

Pezotettix rotundipennis Bl., 4, XXIII, 1891, 80 (nec. Scudder).

Male below the medium in size; female much larger and more robust. Head prominent, the occiput and vertex elevated a little above the pronotum, the interspace between the eyes nearly twice (male) or more than twice (female) the breadth of basal joint of antennæ; the front half strongly sloping downward, narrowly and shallowly sulcate in the male, broadly depressed with distinct raised margins in the female. Frontal costa about the width of the inter-

space between the eyes; distinctly sulcate in the male; a little depressed about the ocellus in the female. Eyes, large, prominent. Antennæ as long (male) or three-fourths as long (female) as hind femora. Pronotum rather long, faintly (male) or distinctly (female) widening on the posterior half; median carina distinct and equal throughout; front and hind margins truncate in the female, the latter a little rounded in the male; prozona twice as long as the densely punctate metazona. Tegmina shorter than the pronotum, obovate or broadly ovate in outline, a little longer than their greatest breadth, their inner edges widely separated in the female, less widely but never touching in the male. Wings represented by a slender oblong scale. Male abdomen well recurved; the cerci rather slender, the middle third but little more than half the width of base, the apical third again somewhat widened and slightly excavated on the outer face, the apex truncate. Furcula, consisting of a pair of tapering, cylindrical, diverging lobes, about one-third the length of supra-anal plate. Subgenital plate almost as broad as long, the apex not elevated. (See Fig. 4, Plate I.)

Color: Above, dull grayish brown or tan. A dark fuscous band starts from the middle of hind margin of each eye, and passes back, covering the upper half of lateral lobe of pronotum, then narrows and curves downward to coxa of middle leg. Below, this is bordered by an ivory white band which extends back from the cheek and covers the lower half of the lateral lobe, and then curves down between the front and middle coxa. Metapleurite ivory-white. Below, the general color is a dirty yellowish brown, with the lower face of the femora orange yellow. The hind femora with their knees black, and with two indistinct blackish bars on the upper and outer faces. Hind tibiæ olive green, annulate with whitish near the base, the spines black. Antennæ with the basal half reddish-brown, the apical half fuscous.

Measurements: Length of body, male, 16 mm., female, 24 mm.; of antennæ, male, 10 mm., female, 9.5 mm.; of pronotum, male, 4.5 mm., female, 6 mm.; of tegmina, male, 3 mm., female, 4 mm.; of hind femora, male, 10 mm., female, 12.5 mm.



Fig. 66. *Melanoplus obovatipennis* Bl. Female. One and one-half times natural size. (Original.)

This olive brown, short-winged locust probably occurs throughout the southern two-thirds of the State, but has been taken only in Crawford, Washington, Monroe, Franklin, Wells, Marion and Vigo counties. In central Indiana it reaches maturity about September 1st, and frequents, for the most part, high, dry, open woods, especially those in which beech and oak trees predominate. On the tops of the hills, in the coal district of Vigo County, where the soil is a clay, and the herbaceous vegetation somewhat limited, it is the prevailing, and often only, representative of the family. In late October, if the season is dry, it is often found in company with *Dicro-morpha viridis* and *Truxalis brevicornis* among the reeds and tall rank grasses near the borders of marshes, and as late as November 22d, has been noted enjoying the afternoon sunshine from a perch on the bottom plank or rail of a fence. The females are always much more numerous than the males, the ratio being about eight to one. Their larger, robust form renders them more clumsy, and hence more readily caught by the hand, the males being active leapers, and requiring quick movement on the part of the collector to effect their capture. The range of the species is given by Scudder as "Indiana to Arkansas and Texas."

63. MELANOPLUS GRACILIS (Bruner). The Graceful Locust.

Pezotettix gracilis Brun., 20, VIII, 1876, 124; Scudd., 165, XII, 1880, 75; Bl., 4 XXIII, 1891, 81; Id., 11, XXVI, 1894, 223.

Melanoplus gracilis Scudd., 179, XXXVI, 1897, 16, 35; Id., 181, 1897, 130, 327, Plate 22, Fig. 3; Id., 188, 1900, 59; Lugg., 84, 1898, 188.

Pezotettix minutipennis Thom., 209, I, 1876, 66; Id., 211, IX, 1880 90, 119.

Size below the medium. Vertex not swollen nor elevated above the pronotum; the interspace between the eyes very narrow, about equalling the width of first antennal joint (male) or nearly twice as broad (female); the front half strongly sloping downward and narrowly but distinctly sulcate (male) or broadly and shallowly sulcate (female). Frontal costa prominent, slightly wider than the interspace between the eyes; feebly or not at all sulcate. Antennæ about three-fourths the length of hind femora. Pronotum, sub-cylindrical, faintly expanding on posterior half; the disk with the sides sloping; the median carina low but distinct and equal throughout; front margin truncate, hind margin broadly rounded, with a median shallow notch; prozona twice the length of metazona. Tegmina about the length of the prozona, narrowly oblong, their inner edges widely separated. Hind femora very slender. Extremity of male abdomen

moderately recurved; the cerci long, narrow, the middle third but half as broad as the base, the apical third a little expanded and flattened. Furcula consisting of a pair of minute rounded lobes. (See Fig. 5, Plate I.)

Color: Dull ash or wood brown above; greenish yellow beneath. Head greenish yellow except on occiput, where it is brownish. A dull blackish bar extends backward from eye along the upper half of lateral lobe of pronotum; the lower half of the lateral lobe greenish yellow. Hind femora bright green (becoming dark in drying) except the knees, which are black. Hind tibiae green, the spines black.

Measurements: Length of body, male, 16 mm., female, 20 mm.; of antennæ, male, 9 mm., female, 8 mm.; of pronotum, male, 4.5 mm., female, 5 mm.; of tegmina, male, 3 mm., female, 4 mm.; of hind femora, male, 9.5 mm., female, 11 mm.

This is, next to *M. scudderi*, our most common of the short-winged members of the genus. It probably occurs throughout the State, but has not been noted in the counties south of Monroe and Knox. It frequents rather low, wooded blue-grass pastures and is especially fond of resting and mating upon the foliage of the iron weeds (*Vernonia*) which grow abundantly in such places. It is also partial to the tall grasses growing in ravines and along the borders of sloughs and marshes. In central Indiana the males begin to reach maturity by June 15th, the females about a week later. By July 5th they are mating in numbers. They have also been noted mating as late as November 10th, and it may be possible that in favorable seasons, a second brood matures. Like most other wingless species, they are active leapers, the males, especially, being noted for their somersaults while endeavoring to escape capture. The range of *gracilis* is given by Scudder as "Indiana and Kentucky to Nebraska and Dakota."



Fig. 67. *Melanoplus gracilis* (Bruner). Male. One and one-half times natural size. (Original.)

64. *MELANOPLUS MORSEI* sp. nov.

Male below the medium in size; female larger and more robust. Head not prominent, the vertex but little swollen, and not at all (male) or a little (female) elevated above the pronotum; the interspace between the eyes very narrow, about as wide (male) or less than one and one-half times as wide (female) as the basal joint of

antennæ; the front half gently sloping and distinctly angulate on the middle of each side, sulcate in the male, plane in the female. Frontal costa a little wider than basal joint of the antennæ, very feebly sulcate below the ocellus in male. Eyes of male very prominent. Antennæ as long (male) or two-thirds as long (female) as hind femora. Pronotum faintly expanding on posterior half in male, or distinctly throughout in the female; the median carina low but distinct except on posterior third of prozona, where it is sub-obsolete; the sides of disk distinctly sloping downward; the front margin truncate, the hind margin sub-truncate with a broad but shallow median notch or emargination; the prozona twice the length of the rather coarsely punctate metazona. Tegmina broadly ovate or sub-rounded, as broad



Fig. 68. *Melanoplus morsei* sp. nov.
Male. One and one-half times
natural size. (Original.)

by a space equal to two-thirds their breadth. Extremity of male abdomen strongly recurved; the cerci rather broad, sub-falcate, the middle third more than half the width of base, the apical third expanded and curved upward or forward, excavated on the outer face, the apex obliquely rounded.

Furcula consisting basally of a pair of broad, flat lobes, whose inner edges meet and overlie the median sulcus of supra-anal plate; about the middle they suddenly narrow and become slightly bifid, the outer fingers, slender, a little divergent, reaching nearly to middle of supra-anal plate, the inner ones forming a very short process or angulation. Sub-genital plate longer than broad; distinctly narrowing from below upward. (See Fig. 6, Plate I.)

Color grayish or purplish brown above, greenish yellow below. Face greenish yellow more or less sprinkled with fuscous. A broad shining black bar extends back from eye along the upper half of pronotal lobe; this bordered below with greenish yellow. Tegmina wood brown. Hind femora reddish brown, or with a fuscous tinge in female, the knees shining black. Hind tibia pale green, the spines black.

Measurements: Length of body, male, 18 mm., female, 24 mm.; of antennæ, male, 11 mm., female, 8 mm.; of pronotum, male, 4.5 mm., female, 5.5 mm.; of tegmina, male, 4 mm., female, 5 mm.; of hind femora, male, 11 mm., female, 12 mm.

In color and general appearance this locust bears a close resemblance to *M. oboratiipennis* and it was not until I came to study them critically that I found them distinct. On comparing the two, *morsei*

is easily distinguished by its less prominent head, larger eyes, narrower interspace between the eyes, more feebly sulcate frontal costa, longer antennæ of male, more coarsely punctate metazona, broader tegmina and especially by the form of the male cerci and furcula. So far it has been noted only along roadsides and in bare limestone glades on the crests of high wooded hills near Wyandotte, Crawford County. It probably occurs in similar situations throughout the southern third of the State. It reaches maturity some time in June, the first specimens having been taken on the 24th. Nothing distinctive of its habits is known, as when in the field it was thought to be *obovatifemnis*; which, however, is a much later maturing insect.

Since the above was in type I found (July 15, 1903) *morsei* to be rather common among the underbrush of high wooded slopes on the State University farm, three miles southeast of Mitchell, Lawrence County. Here the soil was very sparsely vegetated, sedges and wild asters being the prevailing herbs. The ground was covered with the dead leaves of last season, with whose colors the hues of the locusts so blended that they were invisible while motionless. The males leap briskly when approached, but only for a short distance. The heavier bodied females are more clumsy, and are easily caught with the hand.

I take pleasure in naming this locust in honor of Prof. A. P. Morse, of Wellesley, Massachusetts, a special student and collector of Orthoptera, who has kindly shown me many favors during the preparation of the present paper.

65. *MELANOPLUS FASCIATUS* (Barnston-Walker).

Acridium fasciatum Barn., MS., 1870.

Caloptenus fasciatus Walk., 219, IV, 1870, 680; Thom., 206, V, 1873, 224.

Melanoplus fasciatus Scudd., 179, XXXVI, 1897, 14, 23, 34; Id., 181, 1897, 129, 134, 267, Plate 18, Figs. 2-4; Id., 188, 1900, 57; Lugg., 84, 1898, 210, Fig. 136½; Morse, 100, VIII, 1898, 257; 260, 281, Plate 7, Fig. 39.

Pezotettix borealis Scudd., 141 VII, 1862, 464; Thom., 206, V, 1873.

Melanoplus borealis Beut., 3, VI, 1894, 308.

Melanoplus rectus Scudd., 163, XIX, 1878, 284; Id., 161, VI, 1878, 43; Id., 164, 1879, 60; Fern., 53, 1888, 31.

Melanoplus curtus Scudd., 164, 1879, 59.

Size, medium. Head not prominent, the vertex distinctly elevated above the pronotum, the interspace between the eyes as broad (male) or nearly twice as broad (female) as the basal joint of antennæ; the front half strongly sloping downward, shallowly sulcate, the lateral margins distinct. Frontal costa as broad as the interspace between

the eyes, feebly or not at all sulcate. Eyes relatively small, not prominent. Antennæ about as long (male) or two-thirds as long (female) as hind femora. Pronotum feebly expanding on its posterior half; the disk rounded on prozona, flat on metazona; the front margin truncate, the hind margin broadly rounded or obtuse angled; the median carina distinct only on metazona, faintly visible on portions of the prozona; the latter about one-fourth longer than the metazona. Tegmina covering half (female) or three-fourths or more (male) of the abdomen,* sub-lanceolate, their inner edges overlapping. Extremity of male abdomen well upturned; the cerci straight, about four times as long as broad, the middle third but slightly narrowed, the apical third concave or sulcate, the tip rounded. Furcula consisting of a pair of minute, widely separated tubercular teeth. Sub-genital plate longer than broad, the apical margin somewhat elevated. (See Fig. 7, Plate I.)

Color: Dull grayish brown above, clay yellow below; the male the darker. Occiput fuscous. The usual black band behind the eye, extending along the upper half of lateral lobe of prozona. Tegmina, dull reddish brown, with often a few small fuscous spots on the discoidal area. Hind femora dull brownish yellow, with two broad oblique blackish bars on the upper and outer faces; the lower face dull red; the knees black. Hind tibiæ either red or pale green, with a lighter ring near the base; the spines black.

Measurements: Length of body, male, 17 mm., female, 21 mm.; of antennæ, male, 9.5 mm., female, 8 mm.; of pronotum, male, 4.5 mm., female, 5 mm.; of tegmina, male, 7.5 mm., female, 8 mm.; of hind femora, male, 10 mm., female, 15 mm.

This much described locust is a species of northern range, which has been taken in Indiana only in Marshall and Lake counties. In the former it has been noted only in a low sandy oak woods, bordering Lost Lake, and just west of the station of Arlington at Lake Maxinkuckee. Here among low huckleberry and other bushes it is common from July 15th on, the females, however, far outnumbering the males. Both sexes leap vigorously when disturbed, but often squat close to the ground after being flushed once or twice. In Lake County a few specimens have been taken in the sand dune region near Millers.

* A form (*M. f. volaticus*) occurs in which the tegmina are broad, sub-equal, and far surpass the hind femora. It has been taken in Michigan, but is not, as yet, known in Indiana.

66. *MELANOPLUS BLATCHLEYI* Scudder.

Melanoplus blatchleyi Scudd., 179, XXXVI, 1897, 15, 34; Id., 181, 1897, 129, 322, Plate 21, Fig. 10; Id., 188, 1900, 55; Bl., 15, XXX, 1898, 62; Lugg., 84, 1898, 186, Figs. 112-114.

Pezotettix occidentalis Brun., 20, VIII, 1876, 124; Bl., 11, XXVI, 1894, 243.

Pezotettix viola Bl., 4, XXIII, 1891, 81.

Size, above the medium. Vertex scarcely elevated above the pronotum, the interspace between the eyes nearly (male) or fully (female) twice as broad as the first joint of antennæ; the front half moderately sloping, broadly sulcate in the male, faintly in the female. Frontal costa short, not reaching clypeus, sulcate at and below the ocellus. Antennæ scarcely shorter than (male) or two-thirds as long as (female) the hind femora. Pronotum feebly expanding on the metazona; the disk flat or nearly so; the median carina distinct



Fig. 69. *Melanoplus blatchleyi* Scudder. Male. Twice natural size. (After Lugg.)

only on the metazona; the front margin truncate, the hind margin broadly obtuse angled; the prozona about one-third longer than the closely punctate metazona. Tegmina about one-fourth longer than the pronotum, sub-lanceolate, their inner edges slightly overlapping. Fore and middle femora much swollen in the male. Extremity of

male abdomen strongly recurved; the cerci coarse and heavy, the middle third, two-thirds as broad as base, the apical third slightly enlarged, curved abruptly inward, compressed, the tip broadly rounded. Furcula consisting of a pair of short, rather broad and flat triangular teeth whose bases almost touch. Sub-genital plate broader than long, the apex a little elevated. (See Fig. 8, Plate I.)

Color: Dark grayish brown above, yellowish below. Face dull brown, the occiput darker. A rather narrow black bar runs back from each eye along the upper third of lateral lobes of prozona, often indistinct or wanting, especially in the female. Disk and lower half of lateral lobes of pronotum and tegmina grayish brown, often more or less flecked with fuscous. Hind femora reddish or yellowish brown, with two crossbars of black on upper and outer faces, these sometimes indistinct in female; the lower face pale or vermilion red, the knees black. Hind tibiae red, with a pale ring on basal third, the spines black.

Measurements: Length of body, male, 21 mm., female, 24 mm.; of antennæ, male, 12 mm., female, 9.5 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 8 mm., female, 9 mm.; of hind femora, male, 13 mm., female, 14 mm.

This clumsy bodied insect is among the least common of our Indiana Melanopli, having been taken only in Crawford, Knox, Monroe, Vigo, Putnam and Marion counties. Seldom more than a dozen or two are seen each season. It frequents, for the most part, upland woods and thickets, though it is sometimes found along the borders of marshes and swamps, but never close to the water. It is more arboreal than many of our locusts, having been taken in autumn on prickly ash and buttonbush shrubs, several feet above the ground, and also from the boles of hackberry and oak trees, where it was probably sunning. Luger states that in Minnesota "it is very common, preferring the edges of forests or places overgrown with bushes and vines. The grapevine, especially, is preferred by these locusts, and they soon destroy its foliage by eating big holes in the leaves."

In central Indiana *blatchleyi* begins to reach maturity by June 14th, and ragged, forlorn looking specimens have been seen as late as November 3d. Its general range is west of the Mississippi, Marion County, Indiana, being the most easterly point from which it has been recorded.

67. *MELANOPLUS ATLANTIS* (Riley). The Lesser-Locust.

Caloptenus atlantis Riley, 116, VII, 1875, 169; Id., 117, VIII, 1876, 113, 153; Id., 121, VI, 1881, 89, 90; Id., 122, II, 1884, 194; Id., 127, XXV, 1891, 26, Figs. 4a-c; Pack., 216, III, 1883, 273, Plates XX, XXI.

Caloptenus atlantis Thom., 209, I, 1876, 68; Id., 211, IX, 1880, 92, 96, 124.

Melanoplus atlantis Scudd., 163, XIX, 1878, 286; Id., 161, VI, 1878, 45.

Melanoplus atlantis Scudd., 215, II, 1880, 24, Plate XVII, Fig. 6; Id., 179, XXXVI, 1897, 20, 32; Id., 181, 1897, 132, 178, Plate 12, Fig. 7; Id., 188, 1900, 54; Fern., 53, 1883, 31, 33; Bl., 4, XXIII, 1891, 98; Brun., 26, XXVII, 1892, 12; Id., 28, XXVIII, 1893, 29, Figs. 14a-c; Beut., 3, VI, 1894, 306; Morse, 100, VIII, 1898, 256, 259, 279, Plate 7, Fig. 36; Lugg., 84, 1898, 190, Figs., 116-118.

Size, medium. Vertex somewhat elevated above the pronotum, the interspace between the eyes nearly (male) or fully (female) twice as broad as the basal joint of antennæ; the front half strongly sloping, distinctly sulcate in the male, shallowly in the female. Frontal costa short, not reaching clypeus; feebly or not at all sulcate below the ocellus, the upper third a little narrowed. Antennæ three-fourths



Fig. 70. *Melanoplus atlantis* Riley. Male. Natural size.

(male) or two-thirds (female) as long as hind femora. Pronotum rather short, distinctly expanding on the metazona, the disk flat or nearly so, the hind margin obtuse angled, the median carina distinct only on the metazona; the latter densely punctate and equaling the prozona in length. Tegmina fully developed, surpassing the hind femora. Extremity of male abdomen but little recurved; cerci about twice as long as broad, the apical half slightly upturned and somewhat inbent; the apex well rounded. Furcula consisting of a pair of moderately diverging slender, tapering spines, about one-third the length of the supra-anal plate. Sub-genital plate narrowing regularly from below upward, the apex somewhat thickened and elevated, and with a distinct median notch. (See Fig. 9, Plate I.)

Color, either dark grayish or reddish brown. Head olive brown mottled with darker. The usual black band behind eye is confined to the prozona and in the reddish brown specimens and the females is often indistinct or broken into smaller spots. Tegmina grayish brown, flecked distinctly with fuscous along the discoidal area. Hind femora reddish yellow, with two oblique dark bars across the upper and outer faces; the lower face usually pinkish, the knees blackish. side of abdomen yellow.

Measurements: Length of body, male, 20 mm., female, 24 mm.; of antennæ, male, 9 mm., female, 8 mm.; of pronotum, male, 5 mm., female, 5.5 mm.; of tegmina, male and female, 20 mm.; of hind femora, male, 12 mm., female, 13 mm.

This is a very common locust throughout the State, having been taken in every county in which collections have been made. It begins to reach maturity the latter part of May—May 27th and 30th, Vigo County; May 31st, Marion County—and from then until late November may be noted almost anywhere in open blue-grass pastures and woods, borders of roadsides and cultivated fields, meadows and lawns. Numerous examples have been found pairing as late as November 22d, and it may be that there are two broods each season. In late spring and early summer they are often seen resting on iron-weeds and thistles in company with *M. gracilis*, *M. luridus* and other species. The cast off skin of their final moult is often noted on such weeds, showing that the nymph climbs thereon to change its garment of youth for one of maturity.

Allanis is very often found associated with the more common *M. femur-rubrum* and is considered that species by most persons who deign to notice such a thing as a locust. The male, however, may be readily distinguished from that of *femur-rubrum* by the notched apex of sub-genital plate, the shorter and less tapering cerci, and by the greater relative length of the tegmina, which extend one-fourth or more their length beyond the tip of abdomen. The dark spots on tegmina are also larger and more distinct in *allanis*. The female of *allanis* may be known by the yellow color of the under side of abdomen which in *femur-rubrum* is reddish brown; and also by the more distinctly banded hind femora. The earlier specimens of *allanis* are, in general, lighter colored and have relatively longer tegmina than those of late autumn, which are very dark gray in hue. The species ranges over most of the United States and Canada.

68. *MELANOPLUS IMPUDICUS* Scudder.

Melanoplus impudicus Scudd., 179, XXXVI, 1897, 22, 32; Id., 181, 1897, 134, 204, Plate 14, Fig. 1; Id., 188, 1900, 60.

Size, medium. Vertex slightly swollen, distinctly elevated above the pronotum; the interspace between the eyes as broad (male) or one and a half times as broad (female) as the first joint of antennæ; the front half strongly sloping, feebly sulcate in both sexes. Frontal costa short, not reaching clypeus, narrow, feebly or not at all sulcate. Antennæ short, two-thirds as long as hind femora. Pronotum expanding but little (male) or more distinctly (female) on metazona,

the disk feebly convex; median carina visible throughout, distinct on metazona; hind margin obtuse angled; the prozona but little, if any longer than the finely punctate metazona. Tegmina* reaching the tip of hind femora in both sexes, moderately broad and tapering. Extremity of male abdomen but little recurved; the cerci narrow, compressed, straight, the middle third about half as broad as the extreme base, the apical third but little expanded, the tip rounded. Furcula consisting of a pair of short, triangular spines which lie upon the bases of the ridges of the supra-anal plate. Sub-genital plate scarcely longer than broad, sub-conical, terminating in a blunt tubercle. (See Fig. 10, Plate I.)

Color: Reddish brown above, yellowish below. Face yellowish brown, dotted with fuscous; occiput and disk of pronotum darker. Antennæ reddish, the apical fourth fuscous. An indistinct black band extends from eye back across the upper half of the lateral lobe of prozona; this often nearly obsolete in the female. Tegmina grayish or reddish brown, with a number of dark spots along the discoidal area. Hind femora reddish brown, with two more or less distinct oblique black bars on upper and outer faces; the lower face orange red; the knees dusky. Hind tibiæ bright red, the spines black.

Measurements: Length of body, male, 18 mm., female, 22 mm.; of antennæ, male and female, 8 mm.; of pronotum, male, 5 mm., female, 5.5 mm.; of tegmina, male and female, 15 mm.; of hind femora, male, 11 mm., female, 12.5.

This is a southern species, heretofore recorded only from Georgia, Mississippi and Arkansas. On July 10, 1902, I found it plentiful on a sandy wooded slope in Gibson County, Indiana, about 10 miles southeast of Mt. Carmel, Illinois, and at a point where the terrace on the Indiana side of the Wabash River meets the sandy uplands. Here, among the scant grass and weeds the insect had found a suitable abiding place. The males take to wing readily when disturbed, but the females seem to depend only on their short hind legs to take them out of sight of their pursuer. Specimens were sent Professor Morse, who kindly verified my determination by comparing them with Scudder's types. It is probable that the species will be found over most of the sand-covered area of the lower Wabash River.

69. *MELANOPLUS FEMUR-RUBRUM* (De Geer). Common Red-legged Locust.
Acridium femur-rubrum DeG., 57, III, 1773, 498, Plate XLII, Fig. 5;
 Harr., 70, 1833, 583; Id., 71, 1841, 141; Id., 72, 1862, 174.
Caloptenus femur-rubrum Burm., 40, II, 1838, 638; Scudd., 141, VII,
 1862, 464; Id., 147, 1872, 250, 253; Glov., 60, 1870, 76, Fig.

* Scudder, in his original description, gives them as "surpassing a little (male) or considerably (female) the hind femora," but this is not true of Indiana specimens.

32; Id., 62, 1872, Plate V, Fig. 11, Plate VIII, Fig. 2; Thom., 206, V, 1873, 163; Id., 211, IX, 1880, 91, 95, 124, Figs. 22, 23; Riley, 116, VII, 1875, 126, Figs. 26, 29; Id., 117, VIII, 1876, 114-118, 153; Id., 119, 1877, 14-17, 27, Figs. 1, 4; Id., 127, XXV, 1891, 27, Fig. 5.

Pezotettix (Melanoplus) femur-rubrum Stal., 200, I, 1873, 79.

Melanoplus femur-rubrum Scudd., 148, I, 1874, 375; Id., 163, XIX, 1878, 285, 287; Id., 161, VI, 1878, 44, 46; Id., 181, 1897, 134, 278, Plate XIX, Figs. 1-4; Id., 188, 1900, 58; Comst., 41, 1888, 108, 110, Figs. 83, 98; Id., 42, 1895, 110, Fig. 120; Fern., 53, 1888, 31, 33; Bl., 4, XXIII, 1891, 98; Id., 16, 1899, 239, Fig. 65; Brun., 30, 1893, 458, Fig. 98; Id., 28, XXVIII, 1893, 30-32, Fig. 15; Id., 31, 1894, 163, 205, Fig. 68; Id., 35, 1899, 133, Fig. 77; Beut., 3, VI, 1894, 306, Plate VIII, Fig. 7; Lugg., 84, 1898, 195, Figs. 121, 122; Morse, 100, VIII, 257, 281, Plate 7, Fig. 40.

Size, medium. Vertex but little elevated above the pronotum, the interspace between the eyes a fourth wider than (male) or fully twice as wide (female) as the first antennal joint; the front half strongly sloping, distinctly sulcate in the male, feebly in the female. Frontal



Fig. 71. *Melanoplus femur-rubrum* (DeGeer). Male. Natural size.

costa as broad as the interspace between the eyes, deeply sulcate below the ocellus in the male. Antennae about three-fourths (male) or two-thirds (female) as long as hind femora. Pronotum feebly expanding on posterior half, the disk flat or nearly so; the hind margin obtuse angled, more so in the female; the median carina visible throughout, more distinct on the metazona; the prozona about equal to the latter in length. Tegmina slightly surpassing the tip of hind femora, distinctly though very gradually tapering. Extremity of male abdomen well recurved; the cerci sub-falcate, tapering rapidly from base to middle, the apical third but little expanded, the apex very obliquely truncate and somewhat incurved. Furcula consisting of a pair of tapering cylindrical spines, about half as long as the supra-anal plate, their apical two-thirds well separated and lying just outside the ridges forming its median sulcus. Sub-genital plate with its apex less than half the breadth of the base, not elevated, truncate, and distinctly rounded. (See Fig. 11, Plate II.)

Color: Reddish brown, or brownish fuscous. Head olive to brownish yellow, the occiput darker with usually a pair of widening fuscous stripes on its sides. Disk of pronotum generally darker than the lower half of lateral lobes; the upper half of these lobes with a broad black bar on the prozona, often sub-obsolete in the female. Tegmina brownish fuscous, sometimes without spots, but more often with fuscous dots of varying size along the basal half of discoidal area. Hind femora reddish brown, the upper half of outer face usually more or less clouded with fuscous which often forms two oblique crossbars on the upper face; lower and inner faces dull yellow or orange. Hind tibiæ deep red, rarely pale yellowish green, the spines black.

Measurements: Length of body, male, 23 mm., female, 25 mm.; of antennæ, male, 10 mm., female, 8.5 mm.; of pronotum, male, 4.5 mm., female, 5 mm.; of tegmina, male, 20 mm., female, 21 mm.; of hind femora, male, 12.5 mm., female, 14.5 mm.

This is the most common and the most injurious of our Indiana locusts. It occurs everywhere in blue-grass pastures and meadows, along roadsides and borders of cultivated fields. In central Indiana it begins to reach maturity about June 5th, and has been seen in numbers and mating as late as November 22d. Those which occur in low damp places are usually darker than those in dry upland localities. The second crop of clover is, in a dry season, often almost wholly destroyed by these insects. When disturbed they either hop vigorously to one side, or fly swiftly and noiselessly straight ahead for 30 or more feet and then suddenly drop to the ground. The species ranges over most all of North America.

70. *MELANOPLUS EXTREMUS* (Walker).

Caloptenus extremus Walk., 219, IV, 1870, 681; Thom., 206, V, 1873, 225.

Melanoplus extremus Scudd., 179, XXXVI, 1897, 24, 34; Id., 181, 1897, 135, 287, Plate 18, Fig. 10; Id., 188, 1900, 57; Bl., 15, XXX, 1898, 57; Morse, 100, VIII, 1898, 257, 259, 292, Plate 7, Fig. 41.

Pezotettix junius Dodge, 45, VIII, 1876, 9.

Melanoplus junius Scudd., 163, XIX, 1878, 286; Id., 161, VI, 1878, 45.

Caloptenus junius Scudd., 165, XII, 1880, 75.

Size, small to medium. Vertex slightly elevated above the pronotum; the interspace between the eyes nearly (male) or more than (female) twice as wide as the basal joint of antennæ; the front half steeply sloping, distinctly (male) or broadly and shallowly (female) sulcate. Frontal costa not reaching clypeus, faintly widening from above downward; feebly sulcate at and below the ocellus. Antennæ

four-fifths (male) or two-thirds (female) as long as the hind femora. Pronotum widening on the metazona, especially in the female; the median carina visible throughout, more distinct on metazona; the hind margin strongly obtuse angled, the angle rounded in the female; the prozona one-third (male) or one-sixth (female) longer than the closely punctate metazona. Tegmina (in Indiana specimens) reaching nearly to tip of abdomen in the male, covering one-half to three-fourths of abdomen in female, rather broad at base, but rapidly tapering to a sub-acuminate apex. Extremity of male abdomen but little recurved; the cerci short and broad, slightly falcate, the basal third feebly tapering, the apical third but little, if any, wider than the middle; the apex obliquely rounded. Furcula consisting of a pair of parallel, tapering, cylindrical spines, about half as long as supra-anal plate, and resting upon the ridges bordering its median sulcus. Sub-genital plate half as broad at apex as at base, the apical margin well rounded, and not elevated. (See Fig. 12, Plate II.)

Color: Dark greenish yellow, tinged with fuscous. Head, greenish yellow, darker above. The usual black bar behind eye extends along the upper half of lateral lobe of prozona; below which the lobe is greenish yellow. Disk of pronotum and tegmina dull olive brown, the latter sometimes with a few small fuscous spots along the discoidal area. Hind femora dull yellow, tinged with reddish brown, usually without traces of dark crossbars; the lower face generally pale orange; knees feebly infuscated. Hind tibiae pale red, or dull yellow, the spines black.

Measurements: Length of body, male, 18 mm., female, 22 mm.; of antennæ, male, 9 mm., female, 7 mm.; of pronotum, male, 4 mm., female, 5 mm.; of tegmina, male, 10 mm., female, 9.5 mm.; of hind femora, male, 10 mm., female, 11.5 mm.

This species first came to my notice in the State on August 6, 1897, when it was found near DeLong, Fulton County, in an open peat bog which was surrounded on all sides by a heavy growth of tamarack, *Larix americana* Michx. But about a dozen specimens were secured, all of which were of the short winged form *M. e. junius*. When disturbed they gave several short, quick leaps, and then burrowed as far as they could into the dense mass of sphagnum moss which everywhere covered the bog. It has since been taken several times in the same place; also in a marsh near the south end of Lake Maxinkuekee; and probably occurs about the most of the peat bogs and marshes of the northern third of the State. Mr. C. H. Bollman evidently found it near Bloomington, Monroe County, since Scudder mentions a specimen so labeled as occurring in the U. S. National Museum.

Extremus is an insect of northern range, Walker's type being recorded from Arctic America. According to Scudder "it probably occurs throughout the larger part of Canada and the northernmost United States. It has also been recorded from several points in Alaska."

71. *MELANOPLUS ANGUSTIPENNIS* (Dodge). The Narrow-winged Locust.

Culoptenus angustipennis Dodge, 46, IX, 1877, 111.

Melanoplus angustipennis Brun., 22, I, 1885, 138; Id., 28, XXVIII, 1893, 24, Fig. 12; Id., 34, 1896, 121, Fig. 23; Id., 36, 1899, 270, Fig. 58; Scudd., 179, XXXVI, 1897, 26, 34; Id., 181, 1897, 136, 305, Plate 20, Fig. 6; Id., 188, 1900, 53; Bl. 15, XXX, 1898, 58; Lugg., 84, 1898, 198, Fig. 123.

Melanoplus coccinipes Scudd., 179, XXXVI, 1897, 26, 34; Id., 181, 1897, 136, 303, Plate 20, Figs. 3-5; Id., 188, 1900, 56.

Size, medium. Vertex feebly swollen, slightly elevated above the pronotum; the interspace between the eyes one and a half times (male) or twice (female) as broad as the basal joint of antennæ; the front half strongly sloping, distinctly and broadly (male) or feebly (female) sulcate throughout. Frontal costa rather wide and equal throughout, faintly sulcate at and below the ocellus. Antennæ about five-sixths (male) or two-thirds (female) as long as the hind femora. Pronotum with the disk feebly enlarging on posterior half, the median carina distinct only on the metazona; the hind margin broadly obtuse angled; prozona distinctly (male) or scarcely (female) longer than the closely punctate metazona. Tegmina reaching or slightly surpassing the tips of hind femora, slender, tapering. Extremity of male abdomen scarcely recurved, the cerci rather short, spatulate, incurved, the middle third narrowest, the apex broadly rounded and hollowed on the outer face. Furcula consisting of a pair of diverging, tapering, cylindrical spines, about a third as long as the plate on which they rest. Sub-genital plate longer than broad, the apex a third narrower than base, and with a slight notch or emargination in the middle. (See Fig. 13, Plate II.)

Color: Dark grayish brown or fuscous; often with a reddish brown tinge. The occiput and disk of pronotum fuscous; the lower halves of lateral lobes lighter. The usual dark bar behind the eye covers the upper half of the sides of prozona. Tegmina brownish fuscous, either without spots or with small, indistinct fuscous ones along the middle area. Hind femora dull yellowish brown, obscurely and obliquely banded with fuscous; the lower face dull yellow; the knees blackish. Hind tibiæ either pale greenish blue or bright red, the spines black.

Measurements: Length of body, male, 20 mm., female, 22 mm.; of antennæ, male, 9.5 mm., female, 8 mm.; of pronotum, male and female, 5 mm.; of tegmina, male, 17 mm., female, 16 mm.; of hind femora, male and female, 12 mm.

This is one of the most common locusts about the south shore of Lake Michigan occurring in company with *M. atlantis* (Riley), *Spharagemon wyomingianum* (Thos.), and others over a large part of the sandy area within five miles of the lake. It seems to prefer such barren localities to those more promising in plant food, since Bruner mentions its partiality for "old breakings and well-fed pastures of many years' use." It probably begins to reach maturity some time in June, as numerous specimens have been found mating in late July.

The hind tibiæ of at least a third of the specimens noted were red instead of blue. Scudder* has based his separation of his nominal species *coccineipes* on the color of the tibiæ and degree of maculation of the tegmina, two extremely variable characters. The cerci and furcula of the red-legged male are the same in form as of the blue-legged one, and I have therefore combined the two species. In this view I am supported by Prof. A. P. Morse, who has kindly compared specimens from northern Indiana with Scudder's types.

Angustipennis is a western species, and has not been noted east of Kansas and Iowa, except in the sand dune region of northwestern Indiana. According to Bruner, it ranges from North Dakota to Texas, and west to Yellowstone, Montana. He also states that it is increasing rapidly in numbers, and is likely in places to become a serious pest. The vegetation of the area which it at present inhabits in Indiana is not sufficient in quantity and value to enable it to do much damage. Several successive favorable seasons might, however, enable it to so increase in numbers as to cause it to migrate into the richer agricultural regions to the south and east.

72. MELANOPLUS MINOR (Scudder).

Coloptenus minor Scudd., 152, XVII, 1875, 478; Id., 153, IV, 1875, 77; Id., 164, 1879, 22.

Melanoplus minor Scudd., 164, 1879, 84; Id., 179, XXXVI, 1897, 29, 35; Id., 181, 1897, 137, 337, Plate 22, Fig. 9; Id., 188, 1900, 61; Bl., 4, XXIII, 1891, 81; McN., 88, VI, 1891, 74; Bent., 3, VI, 1894, 307; Lugg., 84, 1898, 201, Fig. 127; Morse, 100, VIII, 1898, 256, 259, 293, Plate 7, Fig. 42.

Size, medium. Vertex but little elevated above the pronotum; the interspace between the eyes nearly twice (male) or three times

* "Revision of the Melanopli," p. 136.

(female) as wide as the first joint of antennæ; the front half but little sloping downward, distinctly and widely sulcate in the male, depressed but scarcely sulcate in the female, the lateral margins sharp. Frontal costa faintly narrowed between the antennæ, feebly sulcate at and below the ocellus. Antennæ about two-thirds the length of hind femora in both sexes. Pronotum short, distinctly widening on the metazona; the disk broadly convex; the hind margin obtuse angled; the median carina low, but visible throughout, a little less distinct on the prozona; the latter a fourth longer than the finely punctate metazona. Tegmina reaching the tips of hind femora in the female, slightly surpassing them in the male; of nearly equal width throughout. Extremity of male abdomen but little recurved; the cerci with the basal portion stout, four-sided, the apical portion nearly as long, but narrower, bent upward and inward; an inferior angle or process at point of bend; the apex broadly rounded. Furcula consisting of a pair of well separated parallel cylindrical spines, about a fourth the length of the supra-anal plate and overlying the ridges of its median sulcus. Sub-genital plate very short, the apex rounded, the lateral margins incurved near the base. (See Fig. 14, Plate II.)

Color: Above, dark brownish or fuscous, often with a reddish brown tinge, below yellowish. Occiput and disk of prozona darker than the metazona. A shining black bar behind eye extends back along the upper third of lateral lobes of prozona; this bordered below with brownish yellow. Tegmina brownish fuscous, more or less distinctly spotted with darker along the median area. Hind femora brownish yellow, indistinctly and obliquely barred with fuscous on the upper and outer faces; the lower face reddish orange; the knees black above. Hind tibiæ usually pale blue, pinkish at tip, but sometimes red or dull yellow; the spines black.

Measurements: Length of body, male, 18 mm., female, 24 mm.; of antennæ, male, 8 mm., female, 9 mm.; of pronotum, male, 4.5 mm., female, 5 mm.; of tegmina, male, 15 mm., female, 16 mm.; of hind femora, male, 11.5 mm., female, 13.5.

This seems to be one of the rarest of our *Melanopli*, but a half dozen or so specimens having been taken in the State during my collecting, and they only in Vigo, Monroe and Marion counties. It frequents blue-grass pastures, roadsides, and borders of cultivated fields in upland or sandy regions, and when disturbed, flies noiselessly for a short distance. A mature male was taken in Marion County on June 1, 1902. The species resembles *M. femur-rubrum* and *allanis* in general appearance and is very likely to be confounded

with them. It is probably, therefore, more numerous than my observations would denote, and is to be looked for throughout the State, its general range covering "the northern half of the United States and bordering parts of Canada."

73. *MELANOPLUS LURIDUS* (Dodge).

Caloptenus luridus Dodge, 45, VIII, 1876, 11; Riley, 122, II, 1884, 195.

Melanoplus luridus Brun., 216, III, 1883, 60; Id., 22, I, 1885, 138; Scudd., 179, XXXVI, 1897, 29, 35; Id., 181, 1897, 137, 344, Plate XXIII, Fig. 7; Id. 188, 1900, 61; Lugg., 84, 1898, 203, Figs. 128, 129.

Melanoplus collinus Scudd., 163, XIX, 1878, 285; Id., 161, VI, 1878, 44; Id., 179, XXXVI, 1897, 28, 35; Id., 181, 1897, 138, 346, Plate XXIII, Fig. 6; Id., 188, 1900, 56; Fern., 53, 1888, 31; Bl., 4, XXIII, 1891, 99; Id., 11, XXVI, 1894, 244; McN., 88, VI, 1891, 74; Bent., 3, VI, 1894, 306; Morse, 100, VIII, 1898, 256, 259, 294, Plate 7, Fig. 43.

Size, medium. Vertex somewhat swollen, distinctly elevated above the pronotum; the interspace between the eyes slightly wider than (male) or fully half as wide again (female) as the first antennal joint; the front half moderately sloping, shallowly and broadly sulcate in the male, plane in the female. Frontal costa of nearly equal width throughout, faintly sulcate at and below the ocellus in the male. Antennae about three-fourths (male) or two-thirds (female) as long as the hind femora. Pronotum feebly and regularly widening on posterior half; the disk flat or nearly so; the median carina distinct only on the metazona; the hind margin feebly obtuse angulate, the angle rounded; the prozona one-third (male) or but slightly (female) longer than the distinctly punctate metazona. Tegmina reaching tips of hind femora in the male, often a little shorter in the female, moderately broad, distinctly tapering. Extremity of male abdomen but little recurved; the basal half of cerci gently tapering, about twice as long as the greatest breadth; the apical half distinctly forked, the lower branch a little shorter and much narrower than the upper. Furcula consisting of a pair of well separated minute triangular denticulations. Sub-genital plate as broad as long, the apex broadly rounded. (See Fig. 15, Plate II.)

Color: Dark grayish brown varied with fuscous. Face dull bluish gray, with mottlings of brownish purple. Occiput and disk of prozona fuscous. A broad blackish bar extends from eye back along the upper half of lateral lobe of prozona; this often sub-obsolete, especially in the female. Tegmina brownish fuscous, often grayish in the female, with usually a row of fuscous spots along the discoidal area; though sometimes immaculate. Hind femora brownish yellow,

indistinctly and obliquely barred with fuscous on the upper face, the lower face dull orange or yellowish; the knees black. Hind tibiae bright coral red, the spines black.

Measurements: Length of body, male, 19 mm., female, 23 mm.; of antennæ, male, 9 mm., female, 8 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 14 mm., female, 16 mm.; of hind femora, male, 12 mm., female, 14 mm.

This is the species which, in my former papers I have called *M. collinus* Scudd. In his "Revision of the Melanopli," Scudder has said that *collinus* "is very closely allied to *M. luridus*, but differs in its lack of any projecting part of the furcula, the less divergent forks of the cerci, less elevated apical margin of the sub-genital plate and greater maculation of the tegmina." In all Indiana specimens the furcula are visible, and I therefore sent representatives to Prof. A. P. Morse to compare with Scudder's types of both species. This he kindly did and answered as follows: "From an examination of the material in Mr. Scudder's collection and in mine, I believe *M. collinus* Scudd. and *M. luridus* Dodge to be one species. My reasons for so thinking are these: First. The furcula of the male is equally as well developed in *collinus* as in *luridus*. It is as pronounced in one of the type specimens of *collinus* from Vermont as in typical *luridus*, and it occurs very frequently in other New England examples of *collinus*. Second. The other differences stated (Rev. Mel., p. 348) as distinguishing these species, viz., divergence of forks of cerci and degree of maculation of tegmina, are quite as inconstant and valueless as the degree of development of the furcula. Third. The geographical range of each species naturally and adequately supplements that of the other." I have, therefore, combined the two species under Dodge's name, which has priority.

M. luridus probably occurs in all parts of Indiana, though it has been taken only in Crawford, Monroe, Vigo, Putnam, Marion, Wells, Marshall, Laporte and Porter counties. It frequents open, blue-grass pastures and the borders of gravelly and sandy terraces and prairies; and like *M. gracilis* and *M. bivittatus*, delights to carry on its courtship among the leaves and branches of the iron weeds. They begin to reach maturity about July 20th, and may be taken until late November. While of about the same length, the females of *luridus* are much more robust than those of either *M. femur-rubrum* or *M. atlanis*, and the tegmina just reach the tip of or are a little shorter than the abdomen, instead of exceeding it as in those species.

74. *MELANOPLUS DIFFERENTIALIS* (Uhler). The Lubberly Locust.

Coloptenus differentialis Uhl., MS., 1863; Thom., 206, V, 1873, 166; Id., 211, 1880, 91, 96, 127, Fig. 24; Glov., 62, 1872, Plate VIII, Fig. 12; Palte IX, Fig. 4; Plate XI, Fig. 6; Riley, 119, 1877, 89, 194, 198, Fig. 34; Id., 214, I, 1878, 220, 223, 225, 298, Figs. 32, 110, Plate IV, Fig. 1; Id., 122, II, 1884, 194, Fig. 271; Id., 127, XXV, 1891, 30, Fig. 8.

Aceridium differentiale Thom., 202, V, 1865, 450.

Melanoplus differentialis Brun., 22, I, 1885, 139; Id., 23, 1888, 88, Fig. 4; Id., 26, XXVII, 1892, 32; Id., 28, XXVIII, 1893, 15, Fig. 5; Id., 30, 1893, 461, Fig. 103; Id., 31, 1894, 163, 204, Fig. 67; Id., 35, 1899, 133, Fig. 76; Id., 36, 1899, 247, 270, Fig. 53; Comst., 41, 1888, 108, Fig. 100; Bl., 4, XXIII, 1891, 99; Id., 15, XXX, 1898, 62; Id., 16, 1899, 238, Fig. 64; Scudd., 179, XXXVI, 1897, 30, 35; Id., 181, 1897, 138, 349, Plate XXIII, Figs. 3, 4; Id., 188, 1900, 57; Lugg., 84, 1898, 204, Figs. 130-132.

Size, large. Vertex gently arched, but little elevated above the pronotum; the interval between the eyes three times or more as broad as the first antennal joint; the front half gently sloping, broadly but not deeply impressed. Frontal costa broad, but narrower than the interspace between the eyes, broadly and shallowly sulcate at and below the ocellus. Antennæ more than twice as long (male)



Fig. 72. *Melanoplus differentialis* (Uhler). Male. One and one-half times natural size.
(After Lugg.)

or fully half as long again (female) as the pronotum. Disk of pronotum expanding feebly on the metazona, flat or nearly so; the front margin slightly convex, the hind margin obtusely and roundly angulate; the median carina distinct and sharp on the metazona, less distinct but visible on the front half of prozona; the metazona a little shorter than the prozona and finely rugulose. Tegmina exceeding the tips of hind femora in both sexes, the narrowest apical portion about half as wide as the broadest basal portion. Hind femora stout and rather short, slightly exceeding the abdomen in the male. Extremity of male abdomen but little recurved, the cerci boot-shaped, the basal half oblong; the apical half expanding and feebly forked, the strongly upcurved upper prong being as long and more than

half as wide as the basal half; the lower prong (heel of the boot) being only a rounded, downward projecting lobe. Furcula absent. Sub-genital plate short and broad, the apical margin thickened. (See Fig. 16, Plate II.)

Color: A nearly uniform dark brownish green, or olive brown above, yellow beneath. The transverse sulci of pronotum and pleural incisions black, as are also one or two small patches on the upper half of lateral lobes of pronotum. Tegmina olive brown, immaculate. Hind femora, either dull or bright yellow, the outer face with narrow black marks arranged herring-bone fashion, the upper, inner face with three oblique black bars. Hind tibiae yellow, with a narrow black basal ring, the spines black.

Measurements: Length of body, male, 30 mm., female, 44 mm.; of antennæ, male, 17 mm., female, 15 mm.; of pronotum, male, 7 mm., female, 10 mm.; of tegmina, male, 29 mm., female, 32 mm.; of hind femora, male, 18.5 mm., female, 22 mm.

This is the largest and at the same time one of the most common and destructive of our Melanopli. It occurs throughout the State, having been taken in every county in which collections have been made. In central Indiana it begins to reach maturity about July 25th, and may be found in favorable seasons until December 1st. In late autumn the females are always worn and bedraggled, while many of the males are bright colored and evidently freshly moulted. The species becomes darker with age and those which mature in autumn are darker than those of midsummer.

In Indiana, the lubberly locust delights in low, damp waste places, such as the margins of lakes and ponds, the borders of streams, fence rows and the margins of low-land cultivated fields. It is especially fond of the greater rag weed, *Ambrosia trifida* L., of the river bottoms, and is often seen by scores feeding upon its leaves, or mating among its foliage. The various species of smartweed, *Polygonum*, which grow in shallow water, are also much frequented by it in early autumn. On October 2, 1894, vast numbers were seen along the edge of a field of low-land corn, the leaves of the marginal rows of which they had almost wholly destroyed. When a stalk was approached they did not desert it but dodged quickly around to the opposite side, much as does a squirrel around the trunk of a tree when pursued. If, however, one took alarm and jumped, all the others in the immediate vicinity did likewise.

On one occasion a specimen of *differentialis* was found feeding upon a dead example of *Dicromorpha viridis*, half or more of the abdomen of the latter having been devoured. The Logger-head

shrike, *Lanius ludovicianus* L., catches many of these and other locusts and often impales them on the barbs of wire fences. On one October day I gathered fully a pint of such impaled insects from a fence row half a mile long, and found that they represented sixteen species; eight of grasshoppers, two of katydids, and six of beetles, all injurious, so that this bird, although savage and blood-thirsty, is of great benefit to the farmer and fruit grower.

M. differentialis, according to Seudder, "inhabits the Mississippi Valley from as far north as latitude 43° to the Gulf, and the region to the west as far as the Pacific, from a somewhat lower latitude to central Mexico. I do not think it occurs above 6,000 feet. It certainly is occasionally one of the most destructive pests in the west, particularly in Kansas, Missouri and Illinois, and it has been noted as injuring grass, alfalfa, Indian corn, beets, orchard trees, mulberry, poplar and catalpa trees, and even grape vines; also dahlias, hollyhocks and other garden flowers have been specified as its food, not to mention the rag-weed, *Ambrosia trifida*." Riley states that "in the vicinity of St. Louis, Missouri, the first specimens of this locust were observed to become winged July 19th. Eggs were laid September 9th. As a deviation from the usual egg-laying habits of the genus * * * the eggs are sometimes very numerous placed under bark of logs that have been felled on low lands. The eggs of this species, unlike those of *spretus*, *allanis* and *femur-rubrum*, are not quadrilinearly but irregularly arranged. * * * The head ends of the eggs in the pod point mostly outward. One hundred and seventy-five eggs have been counted in a single mass." Bruner gives the following summary of its destructiveness and habits: "This insect has very frequently multiplied in such numbers in limited areas over its range as to do considerable injury to cultivated crops growing upon low, moist ground; and has even been known very frequently to spread over higher and drier lands adjoining these, its customary haunts. It is one of the few species of locusts that has thus far shown a tendency toward civilization. This it has done readily, since its habits are in unison with the cultivation of the soil. It is only since the settlement of the country where it originally occurred that it has multiplied so as to become sufficiently numerous as to become a serious pest. * * *

"The eggs are laid in cultivated grounds that are more or less compact, preferably old roads, deserted fields, the edges of weed patches and well grazed pastures adjoining weedy ravines. Egg laying begins about the middle of August and continues into October, varying, of course, according to latitude and climatic conditions. Us-

ually, but not always, only a single cluster of eggs is deposited by each female. Frequently there are two, and in extreme cases perhaps even three, of these clusters deposited by a single female."

75. *MELANOPLUS BIVITTATUS* (Say). The Yellow-striped Locust.

Gryllus bivittatus Say, 138, IV, 1825, 308; Id., 139, II, 1859, 237.

Caloptenus bivittatus Uhl., in Say, 139, II, 1859, 238; Pack., 104, 1869, 570; Glov., 62, 1872, Plate I, Fig. 16; Thom., 206, V, 1873, 166; Id., 211, IX, 1880, 91, 96, 126; Riley, 119, 1877, 89, 194, Fig. 38; Id., 214, I, 1878, 220, 226, 327, 459, Fig. 111; Id., 122, II, 1884, 194, Fig. 272; Id., 127, XXV, 1891, 31, Fig. 9.

Melanoplus bivittatus Scudd., 148, I, 1874, 376; Id., 179, XXXVI, 1897, 31, 35; Id., 181, 1897, 138, 363, Plate XXIV, Fig. 5; Id., 188, 1900, 54; Bl., 4, XXIII, 1891, 99; Id., 11, XXVI, 1894, 244; Id., 16, 1899, 244, Fig. 70; Brun., 28, XXVIII, 1893, 19, Fig. 8; Id., 30, 1893, 461, Figs. 104-105; Id., 31, 1894, 163, 205, Fig. 71; Id. 35, 1899, 133, Fig. 80; Id., 36, 1899, 247, 270, Fig. 50; Bent., 3, VI, 1894, 308, Plate VIII, Fig. 8; Lugg., 84, 1898, 206, Figs. 133-135.

Caloptenus femoratus Burm., 40, II, 1838, 638.

Melanoplus femoratus Scudd., 163, XIX, 1878, 284, 288; Id., 161, VI, 1878, 43, 47; Id., 179, 1897, XXXVI, 31, 35; Id., 181, 1897, 138, 360, Plate XXIV, Fig. 4; Id., 188, 1900, 58; Comst., 41, 1888, 108, 110, Fig. 99; Fern., 53, 1888, 31, Fig. 13; Morse, 100, VIII, 1898, 257, 258, 294, Plate 7, Fig. 45.

Aceridium flavovittatum Harr., 71, 1841, 140; Id., 72, 1862, 173; Emm., 49, V, 1854, 147; Rathv., 109, 1862, 384.

Size, large. Vertex gently swollen, but little elevated above the pronotum; the interspace between the eyes about three times the width of first antennal joint; the front half feebly sloping, broadly and shallowly sulcate. Frontal costa broad, sub-equal, feebly sulcate at and below the ocellus. Antennæ about as long (male) or two-thirds as long (female) as the hind femora. Pronotum enlarging feebly on posterior half, more distinctly in female, the disk nearly flat, the hind margin broadly rounded; the median carina low but visible throughout; the prozona fully a half (male) or about one-third (female) longer than the closely and delicately punctate metazona. Tegmina reaching or a little surpassing the hind femora, sometimes a little shorter in the female, tapering regularly and gradually from base to tip. Hind femora rather long and moderately stout. Extremity of male abdomen but little upcurved; the cerci very stout, large and broad, the basal half narrowing gently, and beyond the middle expanding into two lobes; an upper, ovate, compressed one, nearly as long as the basal half, directed upward and backward; and a lower, short triangular one, broader than long, directed downward. Furcula consisting of a pair of short, much swollen, triangu-

lar, widely separated lobes. Sub-genital plate narrow, the apex a little elevated and ending in an obtuse tubercle. (See Fig. 17, Plate II.)

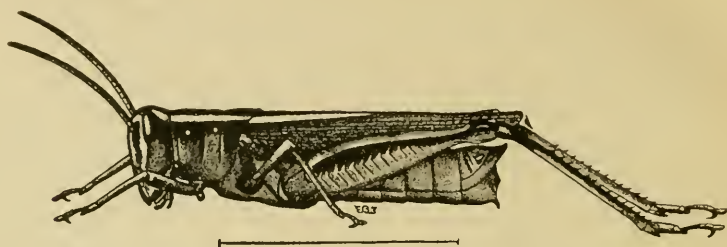


Fig. 73. *Melanoplus bivittatus* (Say). Female. One and one-quarter times natural size. (After Lugger.)

Color: Dull olive brown above, yellowish beneath. Face either yellow or olive green. Occiput and disk of pronotum reddish or olive brown. A narrow yellowish stripe extends back from the upper angle of each eye along the lateral carinae of pronotum nearly to the tips of the tegmina; this usually bordered below with blackish on head and lateral lobes of pronotum. Tegmina with often a few fuscous dots along the discoidal area, but sometimes immaculate. Hind femora dull yellow, more or less infuscated along the upper half of outer face; the lower face yellow; the knees partly infuscated. Hind tibiae usually bright coral red, with black spines; sometimes purplish or greenish yellow.

Measurements: Length of body, male, 28 mm., female, 37 mm.; of antennae, male, 16 mm., female, 14 mm.; of pronotum, male, 7 mm., female, 9 mm.; of tegmina, male, 22 mm., female, 24 mm.; of hind femora, male, 16 mm., female, 21 mm.

This is also a very common locust throughout the State. It begins to reach maturity about June 15th, perhaps earlier in the southern counties, and has mostly disappeared by mid-September. It frequents clover fields, open blue-grass pastures, prairies and roadsides, and is to be found in both moist and dry localities. When flushed, it usually leaps vigorously; seldom flying; and then noiselessly and for a short distance. It delights to rest on the branches and foliage of the iron weeds and other Compositae, and is often found after death, clinging to them and to tall grasses, where it has fallen a prey to the locust fungus. More than any other of our *Melanopli* it seems to be subject to the attacks of the red locust mite, *Trombidium locustarum* Riley. In August I once noted, in Putnam County, a large male with a dozen or more of the mites in different stages, attached to the membrane of the inner wings. A female near

by, with both tegmina and wings absent, had more than 20 of the mites clinging to the thin membrane beneath the metathorax. Old and worn examples of this locust usually have the wings badly damaged.

I have combined the red-legged form *femoratus* with Say's older yellow-legged *bivittatus*, as I have taken the two forms in copulation, and have seen numerous specimens in which the tibiae were brown at base, greenish or glaucous in the middle and red on the apical third. Specimens from New England labeled *femoratus* by A. P. Morse, differ in nowise from those from Indiana, called *bivittatus* by Prof. Lawrence Bruner.

The yellow striped locust ranges from Hudson Bay to North Carolina, and from the Atlantic to the Pacific. It sometimes occurs in such numbers as to be highly injurious. Bruner, in one of his accounts of this species says it is a "lover of rank and succulent vegetation, such as is found upon bottom lands, along the edges of cultivated fields, at the margins of woodlands and on the shaded mountain slopes." When "it develops in large numbers, then these haunts are forsaken, to a greater or less extent, and it spreads over cultivated fields, eating the choicest of everything."

76. *MELANOPLUS PUNCTULATUS* (Uhler). The Grizzly Locust.

Caloptenus punctulatus Uhl., MS., 1862; Scudd., 141, VII, 1862, 465; Thom., 206, V, 1873, 163.

Melanoplus punctulatus Scudd., 148, I, 1874, 376; Id., 163, XIX, 1878, 285; Id., 161, VI, 1878, 44; Id., 179, XXXVI, 1897, 32, 35; Id., 181, 1897, 139, 374, Plate XXV, Fig. 4; Id., 188, 1900, 63; Fern., 53, 1888, 31; Beut., 3, VI, 1894, 252, 307; Bl., 15, XXX, 1898, 62; Id., 16, 1899, 187; Lugg., 84, 1898, 208, Fig. 136; Morse, 100, VIII, 1898, 257, 258, 295, Plate 7, Fig. 45.

Caloptenus griseus Thom., 205, V, 1872, 454; Id., 206, 1873, 165; Glov. 62, 1872, Plate XII, Fig. 14.

Melanoplus griseus Bl., 6, XXIV, 1892; 30; Id., 11, XXVI, 1894, 245.

Caloptenus helluo Scudd., 152, XVII, 1875, 476; Id., 153, IV, 1875, 75; Id., 164, 1879, 20.

Melanoplus helluo Scudd., 163, XIX, 1878, 285; Id. 161, VI, 1878, 44.

Size, medium. Head prominent; the vertex swollen and distinctly elevated above the pronotum; the fastigium or front half rapidly sloping and sulcate throughout, the margins much raised between the eyes which are separated by a space twice as wide as the basal joint of antennæ. Frontal costa prominent above, of equal width throughout, sulcate below the ocellus. Eyes large and, in the male, very prominent. Antennæ about as long as (male) or a fourth shorter than (female) the hind femora. Pronotum with its front

border slightly flaring to receive the head; the posterior half widening but little; the median carina usually visible throughout but more distinct on the metazona; the hind margin broadly obtuse angled; the prozona about a third (male) or scarcely (female) longer than the finely rugulose metazona. Tegmina slightly surpassing the hind femora in both sexes; very gradually tapering to a well rounded apex. Extremity of male abdomen moderately recurved; the cerci large, broad; the basal half oblong; the apical half expanded to double the width of the basal, the upward expansion being twice or more as large as the downward. Furcula wholly wanting. Subgenital plate of moderate width, the apex rather abruptly elevated and thickened. (See Fig. 18, Plate II.)

Color: Dark gray, much mottled with blackish. Head and face greenish gray mottled with fuscous; the occiput and disk of prozona darker. The usual black bar behind eye on upper half of lateral lobes is broken and somewhat indistinct. The disk and sides of metazona and the tegmina are thickly sprinkled with numerous rounded or quadrate fuscous spots, which give to the insect a grizzly appearance, quite distinct from any other of our Melanopli. Hind femora alternately and plainly barred with blackish and dull yellow on the upper and outer faces; the lower face and basal third of inner face coral red. Hind tibiae either dull red or gray, or a mixture of both; the spines black. Abdomen clay yellow beneath.

Measurements: Length of body, male, 24 mm., female, 27 mm.; of antennæ, male, 14 mm., female, 12 mm.; of pronotum, male, 5.5 mm., female, 6 mm.; of tegmina, male, 20 mm., female, 22 mm.; of hind femora, male, 13 mm., female, 15 mm.

This prettily mottled locust has been taken in Crawford, Monroe, Vigo, Putnam, Montgomery, Marion, Marshall and Fulton counties, but is nowhere common, seldom more than half a dozen being seen each season. It is preëminently an autumn insect; the first mature specimen having been taken on August 20th, while most of those seen were in October and November after heavy frosts. In central Indiana it frequents for the most part low wooded tracts along streams, where it may often be noted resting on the trunks of trees, two or three feet above the ground. In the northern part of the State it has been found only in the depths of the tamarack swamps of Fulton and Marshall counties. While other *Acerididæ* are common up to the very border of the tamarack growth, this and two species of grouse locusts were the only ones found within this border. Several pairs of *punctulatus* were taken in coitu on September 24th. It is not an active insect; usually after one or two short leaps,

squatting close to the earth, and seemingly depending upon the close similarity of its hues to the grayish lichens about it to avoid detection. The general range of *punctulatus* is given by Scudder as Maine to Virginia and westward to Texas and Nebraska. In most places it frequents the vicinity of pine or coniferous trees, and Walker has recently given an interesting account of its habits as follows: "I found them most numerous on dead stumps and logs, in a wood of second growth white pine, at De Grassi Point, Ontario. They were sometimes seen on the trunks and branches of living trees, but most often on the stumps and fallen trunks of the old forest, and on the pine rails of a snake fence enclosing the wood. They were found only on the borders and more open parts of the woods, where they were to be seen upon almost every stump. I have seen ten females on a single stump. It is in these dead stumps and logs that the females deposit their eggs, in which operation I have observed them repeatedly. The female chooses a crack in the wood or an old beetle boring of suitable size and lowers her abdomen down this, sometimes nearly as much as an inch. Sometimes when the hole is of a large size, only the head and legs of the insect can be seen above it. Unlike *Chalcallis conspersa*, the female of *M. punctulatus* apparently never bores herself, unless merely to make her way through any loose rubbish that might be obstructing the hole. She generally chooses sound or only partly decayed wood.

"I managed to obtain several fragments and one complete packet of eggs. The latter was fixed by the cement substance at its lower end to the wall of the beetle-boring three-eighths of an inch in diameter. It was attached at a distance of about three-quarters of an inch down the hole, and except at the lower end, which was imbedded in a depression in the wall, the packet was quite free. It was covered with a rather thick coating of a porous or vesicular cement substance, which also filled all the spaces between the closely packed eggs. The latter were twenty-three in number, and their arrangement was in general in a longitudinal direction, the anterior ends pointing toward the free end of the packet, but was otherwise irregular. The eggs are 4 to 4.8 mm. long, elongate-elliptical in form, finely and densely punctate, reddish brown."*

* Can. Ent., XXXIII, 1901, 22.

XXXIX. PHCETALIOTES Scudder (1897).

Body elongate, rather slender, a little compressed. Head large, prominent, nearly half as long again as the prozona. Vertex prominent; the narrowest portion one and one-half times as wide as the frontal costa, the front half sloping downward, with a broad, median furrow or depression. Frontal costa with the lower half much wider than the upper; the region just below the ocellus concave. Antennæ about three-fourths the length of hind femora. Pronotum enlarged a little in front to receive the head; the disk with the sides a little sloping, the hind margin broadly obtuse angled; the median carina rather sharp, of equal height throughout, cut by all three of the transverse sulci. Lateral lobes of pronotum with the lower margin obtuse angled near the middle. Tegmina either abbreviate or fully developed. When the former, a little longer than the pronotum, broadly lanceolate, the inner margins touching about the middle. When developed, surpassing the hind femora in both sexes. Hind femora slender, surpassing the tip of abdomen in male, a little shorter in female. Abdomen compressed, carinate above, its apical fourth thickened and curved upward in the male. Cerci depressed, styliiform. Furcula minute, triangular. (See Fig. 19, Plate II.)

One species is known from the United States; the short-winged form of which occurs in northern Indiana.

77. PHCETALIOTES NEBRASCENSIS (Thomas).

Pezotettix nebrascensis Thom., 205, V, 1872, 455; Id., 206, V, 1873, 151; Glou., 62, 1872, Plate XIII, Fig. 2.

Phcetalites nebrascensis Scudd., 177, XXXII, 1897, 205; Id., 181, XX, 1897, 377, Plate I, Fig. 9, Plate 25, Figs. 6, 7; Id., 188, 1900, 65.

Pezotettix autumnalis Dodge, 45, VIII, 1876, 10; McN., 88, VI, 1891, 76.

Caloptenus volueris Dodge, 46, IX, 1877, 112.

Color: Olive green, more or less marked with fuscous. Face olive green, darker above. A broad blackish band back of eye extends along side of pronotum to posterior transverse sulcus. Disk of pronotum and tegmina wood brown. Abdomen of male with the sides greenish, the posterior third of each segment fuscous; in the female the fuscous predominates. Hind femora greenish tinged with reddish brown; the lower face reddish yellow; the knees black. Hind tibiæ dull green, the spines black. The structural characters are given above under the generic heading.

Measurements: Length of body, male, 22 mm., female, 26 mm.; of antennæ, male, 9.5 mm., female, 7 mm.; of pronotum, male, 5 mm.,

female, 6 mm.; of tegmina, male, 6 mm., female, 7 mm.; of hind femora, male, 13 mm., female, 14 mm.

Only the short-winged form of this dull colored locust has been taken in Indiana, and those only in Lake and Porter counties on October 11 and 12, 1898. Just east of Hammond, they were found in a long, low, marshy tract among the leaves of blue flag. The next day they were more abundant about some marshes northwest of Dune Park. The males were strong and active leapers, oftentimes giving several great jumps to a tuft of bunch grass or weeds and gliding down it to the ground, where they squatted close until picked up with the fingers. The females were more sluggish and several were taken from between the stems of grass where they were standing on their heads, after endeavoring to escape by diving downward. This is the most eastern point from which the species has been recorded, its range, as given by Scudder, being from the Rocky Mountains to the Mississippi River, though McNeill has taken it in Rock Island and Henry counties, Illinois.



Fig. 74. *Phauliotes nebrascensis* (Thos.). Male.
(After Lugger.)

XL. PAROXYA Scudder (1877).

Size, medium. Body straight, sub-cylindrical. Head of average size, the eyes very large and prominent. Vertex narrowed between the eyes, but less so than in *Hesperolettix*, the narrowest portion, in the male, being about as broad as the frontal costa, broader in the female; the widened portion in front with a broad lengthwise furrow. Frontal costa prominent above the ocellus, flattened below, scarcely sulcate in the male, more strongly in the female. Antennæ of male usually more than half as long again as head and pronotum together. Disk of pronotum twice as long as average breadth, its edges nearly parallel, the surface flat or nearly so; the prozona half as long again as the metazona, the surface of the latter finely and densely punctate; the hind margin obtusely and bluntly angulate; the median carina low, of equal height throughout, cut only by the last transverse sulcus. Lateral lobes of pronotum vertical, longer than deep, the lower margin with its front half strongly directed upward. Tegmina and wings variable in length, but in our species always much longer than the pronotum. Hind femora of average stoutness, equaling or more usually surpassing the tip of abdomen. Sub-genital plate

of male short, the apex more or less truncate; the cerci long, spoon-shaped, the apex incurved.

Four species are known from the United States, two of which have been described from Indiana.

KEY TO INDIANA SPECIES OF PAROXYA.

- a. Length of body of male, 20 or more mm. Antennæ of male longer than hind femora. Tegmina reaching middle of abdomen in both sexes 78 *hoosieri*, p. 336
- aa. Length of body of male not over 17.5 mm. Antennæ of male but three-fourths the length of hind femora. Tegmina nearly as long as abdomen in female, slightly surpassing abdomen in male. 79 *scudderi*, p. 338

78. *PAROXYA HOOSIERI* (Blatchley). The Hoosier Locust.

Pezotettix hoosieri Bl., 6, XXIV, 1892, 31.

Paroxya hoosieri Scudd., 177, XXXII, 1897, 205; Id., 181, XX, 1897, 381, 382, Plate 25, Fig. 9; Id., 188, 1900, 66; Bl., 15, XXX, 1898, 63.

Paroxya atlantica, Bl., 11, XXVI, 1894, 244.

Antennæ of male very long, exceeding the length of posterior femora. Foveolæ present, almost twice as long as wide, more distinct in the female. Pronotum broadening slightly on posterior half (more noticeable in the female); median carina distinct and equal throughout, the transverse sulci scarcely noticeable in the female, distinct but shallow in the male; the lateral carinæ present but rounded obtusely off; the disk and sides of posterior lobe densely and rather coarsely punctate. Tegmina oblong, two and a half times as long as broad, reaching to middle of abdomen and slightly overlapping on the median dorsal line, the wings but little shorter. Sub-genital plate of male broader than high, the lateral edges higher and flaring slightly outward. Cerci long and slender, gently incurved, narrowed at the middle, with the apical third flattened and slightly hollowed on the exterior face. Furcula consisting of a pair of oblong, parallel, flattened plates, whose inner edges touch; their apical third somewhat tapering and blunt. (See Fig. 20, Plate II.)



Fig. 75. *Paroxya hoosieri* (Bl.). Male. One and one-third times natural size. (Original.)

Color of living specimens: Male, antennæ, light reddish brown, infuscated at tip, and with the apical sixth of each segment yellow-

ish. Face, green; clypeus and mouth parts yellow. Vertex, disk of pronotum and tegmina, plain olive, immaculate. Lateral lobes of pronotum greenish-yellow below; above with a broad, shining black line reaching from the eye to their posterior edge. The under side of abdomen pale yellow, and the metapleura with an oblique yellow line. Femora, green; knees, black; hind tibiae, greenish, yellowish brown at base, with black spines.

Female: Duller; the disk of pronotum and tegmina sometimes with minute fuscous spots; a black stripe on the sides of abdomen, above which are numerous small black blotches.

Measurements: Length of body, male, 22 mm., female, 31 mm.; of antennae, male, 15 mm., female, 11 mm.; of pronotum, male, 5 mm., female, 6 mm.; of tegmina, male, 10 mm., female, 13 mm.; of hind femora, male, 14 mm., female, 17.5 mm.

This species was first noted in Indiana about the margins of the "Goose Pond," Vigo County, on October 11, 1901. It at once attracted attention on account of the length of the male antennae, and the black stripes on the sides of the abdomen of the female. The pond was then almost dry, and the dense growth of sedges and rushes which had filled its shallow margins, were, in some places, burned away. Over the burned spots had sprung up a dense green vegetation, and here this *Paroxya* flourished in company with *Truxalis brevicornis* and *Dicromorpha viridis*, while a few feet away *Leptysmia marginicollis* found a suitable home among the rushes and sedges still standing. Both sexes of *P. hoosieri* were very active, leaping vigorously when approached, and difficult to capture except by throwing the net over them as they rested on the ground. The females were exceedingly difficult to kill in the cyanide bottle, "coming to" after having been kept in it for several hours, although the males were killed in a few minutes. On October 27th, the spot was again visited, and, although several heavy frosts had occurred, yet the species was still fairly common. At this time, however, they were all found in the small patches of grass which grew among the fallen leaves a few yards from the edges of the pond proper.

Since then the species has been found to be rather common in the western and northern portions of the State, having been taken in Gibson, Fulton, Starke, Lake, Kosciusko, Steuben, Whitley and Wells counties, and also by Mr. Lynds Jones near Oberlin, Ohio. In all these localities it occurs about the borders of marshes, especially those bordering the lakes and tamarack bogs of the north. In Gibson County it was found mature on July 10th.

On one occasion I found a female of this species and also one of *Chlæaltis conspersa* Harr., a few inches apart on the stump of a downy poplar, *Populus heterophylla* L., each with the abdomen buried to the full length in the soft wood, but no eggs could be discovered. Nothing has been recorded concerning the habits of oviposition of the members of the genus *Paroxya*, and it would be surprising if they, like the *Chlæaltis* mentioned, should seek wood rather than earth as the receptive matrix for the eggs.

I at one time considered *hoosieri* a short winged form of *P. atlantica*, but, on account of distinctive characters pertaining to the abdominal appendages of the male, Scudder regards it as a valid species.

79. *PAROXYA SCUDDERI* Blatchley. Scudder's Paroxya.

Paroxya scudderi Bl., 15, XXX, 1898, 59; Scudd., 188, 1900, 66.

The smallest known member of the genus, the body of the male averaging but 17 mm. in length. Antennæ relatively short, being but 9 mm. in length in both sexes. Tegmina reaching slightly be-

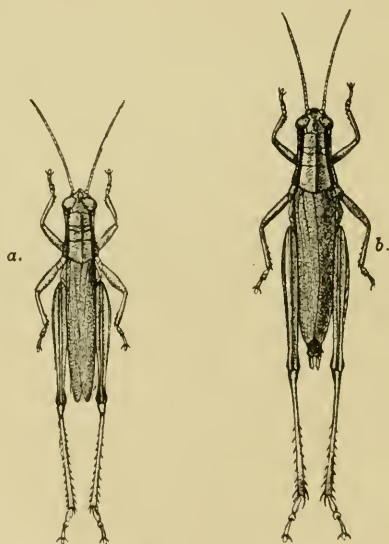


Fig. 76. *Paroxya scudderi* Bl. a, Male. b, Female. One and one-third times natural size. (Original.)

yond tip of abdomen in male, a little shorter than abdomen in female. Supra-anal plate of male very short, triangular, with a short, basal, triangular sulcus, in which rest the furcula. These consist of a pair of flattish, oblong, sub-equal plates with their inner edges

touching except at the apices, where they slightly diverge. Cerci strongly incurved, narrowed at the middle, the basal half stouter than in *P. hoosieri*, the apical third flattened and rounded at the end.

Color: Metazona, tegmina, and upper and outer faces of all the femora of male a uniform light wood brown; occiput and prozona darker. A broad black stripe extends from the eye along the upper half of the lateral lobes of pronotum as far as the posterior transverse sulcus, where it ends abruptly, the posterior lateral lobe being uniform in color with the disk. Below this black stripe is one of ivory white, brightest on the head. Metapleura also ivory white. Face grayish olive, flecked or tinged with yellowish. Basal two-thirds of antennæ the color of the tegmina; apical third darker. Palpi and prosternal spine yellow. Sternites of thorax olive brown; those of abdomen yellow as also the lower faces of all the femora. Hind tibiæ dull, pale green (basal third sometimes light brown), with a black spot at knee; the spines eleven in number in the outer series, with their apical thirds black.

Female darker; the tegmina sometimes obscurely and sparingly flecked with fuscous; the yellow of under side dull or wanting.

Measurements: Length of body, male, 17 mm., female, 24 mm.; of antennæ, male and female, 9 mm.; of pronotum, male, 5 mm., female, 5.5 mm.; of tegmina, male, 13 mm., female, 14.5 mm.; hind femora, male, 11.5 mm., female, 13.5 mm.

This graceful-bodied species was first found in small numbers on July 27, 1897, about the grassy margins of a pond in the sand dune region north of Millers, Lake County, and within one-half a mile of the shore of Lake Michigan. On the following day a single pair were taken from a similar locality near Tolleston, in the same county, and about four miles from the lake, but still within the sand covered area. It was usually found clinging to the stems of the tall rushes and grasses common in such locations, and when disturbed the males used the wings in a noiseless flight, while the females depended upon their leaping powers to escape. When closely followed, they would attempt to hide by burrowing in the fallen grass.

No others were secured until July 24, 1902, when a single male was taken from low ground along a railway southeast of Hammond. On August 20th it was found in numbers in the tall grasses along a lobe of Bass Lake, Starke County.

P. scudderi is more closely allied to *P. atlantica* than to either of the other two known species of the genus, but its smaller size, shorter antennæ of male, longer cerci, and the different shape of the male furcula at once distinguish it. It will probably be found to occur

about low moist places in many of the counties of the northern third of the State.

Family LOCUSTIDÆ.

As already noted the sub-order, *Sallatoria* or Jumpers, includes three families of Orthoptera, one of them being the *Locustidæ*. This family comprises those insects commonly called katydids, green or long-horned grasshoppers and stone or camel crickets.

The distinguishing characters of the members of the family *Locustidæ*, as given in the key, p. 210, are the long, slender, tapering, many-jointed antennæ; the almost universal absence of ocelli or simple eyes; the four-jointed* tarsi or feet; and the sword-shaped or falcate ovipositor of the females, which is made of four flattened plates. The head in many of the species is wedge-shaped and the mouth parts are well developed, the mandibles, especially, being long and sharp pointed. This enables the insect to dig into plant tissue or to eat the seeds of grasses, as many of them do. The males have, in many instances, abdominal appendages corresponding to the parts of the ovipositor, which are used as clasping organs. The tegmina or wing covers, when present, slope obliquely downwards, instead of being bent abruptly, as in the *Gryllidæ* or true crickets; and in most cases, the wings are longer than the tegmina.

The stridulating or musical organ of the males is quite similar in structure to that of the male cricket, being found at the base of the overlapping dorsal area of the tegmina and usually consisting of a transparent membrane, of a more or less rounded form, which is crossed by a prominent curved vein, which, on the under side, bears a single row of minute file-like teeth. In stridulating, the wing covers are moved apart and then shuffled together again, when these teeth are rubbed over a vein on the upper surface of the other wing cover, producing the familiar, so-called "katydid" sound. Each of the different species makes a distinct call or note of its own, and many of them have two calls, one which they use by night and the other by day. Any one who will pay close attention to these different calls can soon learn to distinguish each species by its note as readily as the ornithologist can recognize different species of birds in the same manner. The ear of these insects, when present, is also similar in structure and position to that of the cricket's, being an oblong or oval cavity covered with a transparent or whitish membrane and situated on the front leg, near the basal end of the tibiæ.

* The members of the genus *Daihinia*, no one of which occurs in Indiana, have the fore and hind tarsi three jointed.

The young of *Locustidæ*, like those of the other families of the *Orthoptera*, when hatched from the egg resemble the adults in form but are wholly wingless. As they increase in size they moult or shed the skin five times, the wings each time becoming more apparent, until after the fifth moult, when they appear fully developed, and the insect is mature or full grown, never increasing in size thereafter. Throughout their entire lives they are active, greedy feeders, mostly herbivorous in habit; and where present in numbers necessarily do much harm to growing vegetation.

In the number of species in any given locality, the *Locustidæ* far outrank the *Gryllidæ*, being excelled in this respect among the other Orthopteran families only by the *Acrididæ* or Locusts. According to Scudder, 194 species of the family are known from the United States. Of these, 40 have been taken in Indiana and are described in the present paper, specimens of all being in my private collection. This is seven more than are known in any other State from which lists have been published except Nebraska, where Bruner records the presence of 58 species. McNeill has listed 27 from Illinois; Smith 33 from New Jersey; Osborne 24 from Iowa, and Scudder 23 from all New England.

Six sub-families of *Locustidæ* occur in the United States and all are represented in the Indiana fauna. They may be separated by the following table:

A SYNOPSIS OF THE SUB-FAMILIES OF LOCUSTIDÆ KNOWN TO OCCUR IN INDIANA.

a. Tegmina and wings present.

- b. Prosternal spines absent; vertex rounded or deflexed without spine, tubercle or cone; tegmina always shorter than wings; hind tibiæ with an apical spine on each side.....

PHANEROPTERINÆ, p. 342

- bb. Prosternal spines present; vertex either terminating in a sharp flat spine or produced upward and forward in a rounded tubercle or prominent cone; hind tibiæ with an apical spine on outer side only or on neither.

- c. Wing covers leaf-like, broadly expanded in the middle, concave within, longer than the wings; vertex terminating in a sharp, flat spine; pronotum crossed by two distinct transverse sulci.....

PSEUDOPHYLLINÆ, p. 358

- cc. Wing covers narrow, expanded but little, if any, in the middle, often shorter than the wings; vertex terminating in a rounded tubercle or prominent cone; pronotum without, or with only one, transverse sulcus.....

CONOCEPHALINÆ, p. 362

aa. Tegmina and wings absent, or the former rudimentary.

d. Pronotum extending back to the abdomen; prosternal spines present; fore tibiæ with a hearing organ near the base; tegmina rudimentaryDECTICINÆ, p. 392

dd. Pronotum short, not covering the whole top of thorax; prosternal spines absent; fore tibiæ without a hearing organ near the base; wholly wingless.

e. Eyes ovate, vertical, situated on the side of the basal joint of antennæ; ovipositor ensiform, curved strongly upwardGRYLLACRINÆ, p. 395

cc. Eyes sub-rotund, situated partly above the basal joint of the antennæ; ovipositor nearly straight.....

STENOPELMATINÆ, p. 396

Sub-family PHANEROPTERINÆ.

The species of this sub-family are among the largest of our *Locustidæ*, and, with those of the *Pseudophyllinæ*, are commonly known as "Katydid's." The apex of the head is obtuse or rounded, without cone or spine, and the prosternum is unarmed. The wing covers are shorter than the wings, usually expanded in the middle, and of a bright uniform green color. The wings are folded like a fan and are long and strong, the insects being flyers rather than leapers. The hind limbs, being seldom used except to give themselves an upward impetus at the beginning of flight, while long and slender, are proportionally much smaller in diameter than in the sub-family *Conocephalinæ*, whose members leap rather than fly.

The "katydids" are the most arboreal of all of the *Locustidæ*, the great majority of them passing their entire lives on shrubs and trees, where they feed upon the leaves and tender twigs, and, when present in numbers, often do excessive injury. The color and form of their wings serve admirably to protect them against their worst foes, the birds; and as they live a solitary life, i. e., do not flock together in numbers as do the green grasshoppers, they are but seldom noticed by man. Their love calls, or songs, however, make the welkin ring at night from mid-August until after heavy frost, and though but one or two of the eight species found in the State make a note in any way resembling the syllables "Katy did, she did," yet all are accredited with this sound by the casual observer, and hence the common name usually given to the members of this sub-family. Their call is seldom made by day for the obvious reason, that it might attract the attention of the birds and so lead to the destruction of the songster. As twilight approaches, however, the male of each species begins his peculiar note, which is kept up with little or no

beyond tegmina, 6 mm.; of hind femora, male, 30 mm., female, 32 mm.; of ovipositor, 7 mm. Width of tegmina, 6.5 mm.

Texensis is, in Indiana, one of the most common of the katydids. It has been taken in Crawford, Vigo, Putnam, Henry, Wells, Fulton, Marshall, Porter, Starke and Lake counties. According to Scudder, it ranges over the United States east of the Great Plains. In southern Indiana it probably reaches maturity about July 15th. The earliest date on which I have taken it was July 22d, in Putnam County.

The eggs of *texensis* are laid in the edges of leaves between the upper and lower epidermis, and at first are so thin that they are not



Fig. 77. a. Extremity of male abdomen of *Scudderia texensis* Sauss.—Pict. b. Dorsal view of anal segment of same. (After Scudder.)

noticeable except when the leaf is held between one's self and the light. They are loosely inserted in these pockets made by the ovipositor of the mother, and as they swell in coming in contact with the ruptured tissues of the plant, they are held tightly in place. The winter of this, as well as of the other species of the genus, is passed in the egg stage, the young appearing about the last of April.

This insect is probably less arboreal than any other species of katydid, as it is often found clinging to the tall, coarse grasses and sedges which grow near the borders of lakes, ponds and in damp ravines, and to the coarse weeds along the margins of prairies and meadows. When approached, it flies rapidly in a zigzag, noiseless manner for a long distance to another clump of grass or weeds, or to the lower branches of an oak, a tree in which it delights to dwell.

81. *SCUDDERIA CURVICAUDA* (De Geer). The Curve-tailed Katydid.

Scudderia curvicauda De G., 57, III, 1773, 446, Plate 38, Fig. 3; Brunn., 38, 1878, 240; Sauss.-Pict., 136, 1897, 331, Plate 15, Fig. 20; Scudd., 182, 1898, 274-278, Fig. 3; Id., 188, 1900, 68.

Phaneroptera angustifolia Harr., 71, 1841, 129.

Scudderia angustifolia Scudd., 168, 1892, 67 (note of set to music).

Scudderia fureulata Bl., 7, 1893, 100; Beut., 3, VI, 1894, 275; Lugger, 84, 1898, 217, Figs. 139-140.

This species closely resembles *S. texensis* in size and general appearance, and the females of the two are difficult to distinguish; the males, however, are readily separated by the different form of the notch of the supra-anal spine. The general color of the two species is the same, but the yellow carinal lines of the pronotum are less dis-



Fig. 78. (a) Extremity of male abdomen of *Scudderia curvicauda* (De Geer).
(b) Dorsal view of anal segment of same. (After Scudder.)

tinct or wholly wanting in *curvicauda*. The wing covers vary in width, but are usually broader than in *texensis*; and longer and much less broad, proportionally, than in the next species, *S. pistillata*. The females of *curvicauda* are more robust, and have the serrations on the margins of ovipositor less prominent than those of *texensis*.

Measurements: Male—Length of body, 23 mm.; of tegmina, 35-37 mm.; of posterior femora, 28-30 mm.; of pronotum, 6 mm. Width of tegmina, 7-8 mm. Female—Length of body, 25 mm.; of tegmina, 38 mm.; of posterior femora, 32 mm.; of ovipositor, 7 mm. Width of tegmina, 8.5 mm.

Curvicauda probably occurs in all portions of the State, but is less common than *texensis*. It has been taken in Lake, Starke, Fulton, Marshall, Kosciusko, Putnam, Vigo and Posey counties and is especially common about the marshy meadows bordering some of the lakes and tamarack swamps of northern Indiana. The earliest date on which a mature specimen was taken was July 10th, in Knox County. The general range of *curvicauda* is the same as that of *texensis*. The habits of flight, as far as noted, are also essentially the same as in that species.

In New Jersey, according to J. B. Smith, both *curvicauda* and *texensis* are very common on cranberry bogs, and destroy many of the berries. They eat into the fruit to get at the seed, which they devour, and leave the berry to dry up. A flock of turkeys which will destroy the young of these katydids and drive off those that are winged is probably the most effective remedy.

Mr. S. H. Scudder, who has studied carefully the songs of many species of Orthoptera and has even set a number of them, including that of *curvicauda*, to music, has given a pleasing account of its

song, from which I take the following extract: "It is more noisy by night than by day; and the songs differ considerably at these two times. The day song is given only during sunshine, the other by night and in cloudy weather. I first noticed this while watching one of the little creatures close beside me; as a cloud passed over the sun he suddenly changed his note to one with which I was already familiar, but without knowing to what insect it belonged. At the same time all the individuals around me, whose similar day song I had heard, began to respond with the night cry; the cloud passed away, and the original note was resumed on all sides. Judging that they preferred the night song to that of the day, from their increased stridulation during the former period, I imitated the night song during the sunshine, and obtained an immediate response in the same language. The experiment proved that the insects could hear as well as sing. * * * The note by day is *bzrwi* and lasts for one-third of a second. The night song consists of a repetition, ordinarily eight times, of a note which sounds like *tchw*. It is repeated at the rate of five times in three-quarters of a second, making each note half the length of the day note."

82. *SCUDDERIA PISTILLATA* Brunner.

Scudderia pistillata Brunn., 38, 1878, 240; Beut., 3, VI, 1894, 276; Sauss. Pict., 136, 1897, 328, 332; Lugg., 84, 1898, 220, Figs. 144, 145; Scudd., 182, 1898, 273, 277; Id., 188, 1900, 69.

This species is closely allied to *S. curvicauda* but is shorter bodied, broader winged and shorter legged. The notch of supra-anal spine of male is very similar to that of the male *curvicauda*, but the lateral processes are sub-triangular and distinctly tapering instead of well rounded and of sub-equal breadth as in the latter species. The sub-

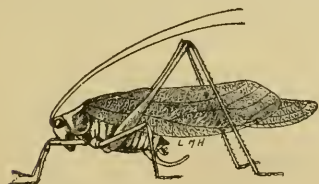


Fig. 79. *Scudderia pistillata* Brunn.
Male. (After Lugg).



Fig. 80. (a) Extremity of male abdomen of *Scudderia pistillata* Brunn. (b) Dorsal view of anal segment of same. (After Scudder).

anal spine is also shorter than in *curvicauda*. The short, broad tegmina and the short hind femora of *pistillata* are the characters which most readily distinguish the two.

Measurements: Male—Length of body, 19 mm.; of tegmina, 32 mm.; of hind femora, 21 mm.; of pronotum, 5.5 mm.; width of tegmina, 10 mm. Female—Length of body, 19 mm.; of tegmina, 27 mm.; of hind femora, 20 mm.; of pronotum, 5.5 mm.; of ovipositor, 6.5 mm.; width of tegmina, 9 mm.

Pistillata is a species of northern range, its general distribution being "Northern United States and Canada east of the Great Plains." It is a scarce insect in Indiana, having, up to the present, been taken in small numbers only about the peat bogs and borders of lakes in Fulton and Kosciusko counties. Mr. Scudder, in his revision of the group, was mistaken in referring the species described in my former paper under the name of *furculata* to *pistillata*; as the measurements in my paper will prove. They belonged to *curvicauda* as at present limited, and are so placed in this paper.

83. *SCUDDERIA FURCATA* Brunner. The Fork-tailed Katydid.

Scudderia furcata Brun., 38, 1878, 239, Fig. 72; Bl., 7, 1893, 101; Bent., 3, VI, 1894, 275; Sauss.-Pict., 136, 1897, 328, 331, Plate 15, Figs. 16, 17; Scudd., 182, 1898, 275-284, Fig. 8; Id., 188, 1900, 68.

Scudderia angustifolia Bl., 7, 1893, 102.

Phaneroptera curvicauda Riley, 115, 1874, 164, Figs., 50, 51. (Text in part.)

This is the smallest, and at the same time, our most common species of the genus. The general color is a dark leaf green, the head and pronotum paler; the latter without trace of yellow on its carinae. The anterior margin of the pronotum is but slightly narrower than the posterior, whereas in the three preceding species the difference in width is plainly perceptible. The notch of the supra-anal spine of the male is deep and rounded, forming a curious fork-like appendage, the lateral processes of which are much swollen.

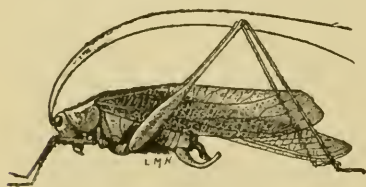


Fig. 81. *Scudderia furcata* Brun. Male. (After Lugger.)



Fig. 82. (a) Extremity of male abdomen of *Scudderia furcata* Brun. (b) Dorsal view of anal segment of same. (After Scudder.)

Measurements: Male—Length of body, 14-16 mm.; of tegmina, 26-31 mm.; of posterior femora, 19-22 mm.; of pronotum, 5 mm.

Width of tegmina, 6 mm. Female—Length of body, 18 to 20 mm.; of tegmina, 26-30 mm.; of posterior femora, 22 mm.; of ovipositor, 5 mm.

Furcata occurs in all portions of the State, having been taken in every county where collections have been made. Its general range includes the United States and southern Canada east of the Great Plains. In central and southern Indiana the first mature specimens appear about July 15th, but they do not become plentiful before the first of August, and I have seen the nymphs in Vigo County as late as September 18th. It is most frequently seen on the low bushes and trees about the margin of thickets and along fence rows, but in the prairie country north it frequents coarse grasses and weeds in company with the preceding species. Its flight is noiseless and seemingly without direction, and is not so prolonged as that of *S. texensis*. I have seen the adult of this species captured and borne away by the sand wasp.

Dr. C. V. Riley (*loc. cit.*), gives the following account of the egg laying habits of *furcata*: "The female stations herself firmly by the middle and hind legs on twigs or leaves contiguous to the one selected to receive the eggs. This leaf is then grasped by the front feet and held in a vertical position, while the edge is slightly gnawed or pared off by the jaws to facilitate the entrance of the point of the ovipositor. When this is done the abdomen is curved under and brought forward, and the ovipositor is seized on its convex edge by the mandibles and maxillæ, which, with the aid of the palpi, guide the point to that portion of the leaf prepared to receive it. After gentle, but repeated efforts, the point of the instrument is finally inserted between the tissues of the leaf, and gradually pushed in to more than half its length. As soon as the cavity is formed, the egg is extruded, and passed slowly between the semi-transparent blades of the ovipositor. As the egg leaves the ovipositor the latter is gradually withdrawn, while the egg remains in the leaf, retained in place, probably, by a viscid fluid that is exuded with it. As many as five of the eggs are sometimes deposited in one row in the same leaf, but more often they are single.

Of the call note of *furcata* Riley also states: "The shrill of the male is by no means so loud as that of the oblong-winged katydid, *Amblycorypha oblongifolia* DeGeer, in which its sound is always drowned in the woods. It consists of a softer *zeep, zeep*, sometimes uttered singly, but generally thrice in succession. The call is occasionally responded to by a faint chirp from the females, produced by stretching out their wings as if for flight, and is as often heard in the day as at night."

XLII. AMBLYCORYPHA Stal (1874).

Head with the vertex flat and without spines; its fastigium deflexed, much broader than the first antennal joint; eyes elliptical or oblong oval. Wing covers broad and rounded at the tip. Stridulating organ of the male, brownish, opaque, traversed by a strong green cross-vein. Supra-anal plate of male short, truncate; sub-anal plate short and broad at base, narrower at apex, with a broad triangular notch, the tips at side of which end in a short, blunt, spine-like process. Ovipositor, broad, of medium length, curved gradually upward from the middle; obtuse or rounded at the end, and with the apical half sharply and strongly serrate on both edges. Six species are listed by Scudder from the United States. Of these, three are known to occur in Indiana.

KEY TO INDIANA SPECIES OF AMBLYCORYPHA.

- a. Size, large; tegmina, 34 to 37 mm. in length; those of the male exceeding the tip of posterior femora.....84 *oblongifolia*, p. 350
- aa. Tegmina not more than 30 mm. in length; those of the male sometimes reaching but not exceeding the tip of the posterior femora.
 - b. Size, medium; greatest breadth of tegmina contained less than three times in their length; ovipositor strongly curved.....85 *rotundifolia*, p. 352
 - bb. Size, small; greatest breadth of wing covers contained from three and one-fourth to three and one-half times in their length; ovipositor but moderately curved.....86 *uhleri*, p. 353

84. AMBLYCORYPHA OBLONGIFOLIA (DeGeer). The Oblong Leaf-winged Katydid.

Locusta oblongifolia DeG., 57, III, 1773, 445, Plate 38, Fig. 2.

Phylloptera oblongifolia Harris, 72, 1862, 159 (Text only); Scudd., 141, VII, 1862, 444.

Amblycorypha oblongifolia Brunner, 38, 1878, 266; Bl., 7, 1893, 104; Bent., 3, VI, 1894, 278; Lugger, 84, 1898, 222, Fig. 147; Scudd., 188, 1900, 70.

This is the largest of the three species occurring in the State, measuring about 45 mm. to the end of the wing covers, which are 3.3 times as long as wide. The wings exceed the wing covers by 5 to 6.5 mm. Anterior margin of pronotum much narrower than the posterior, the lateral carinae sharply defined; the hind margin of deflexed lateral lobes broadly rounded. The inner, lower carina of posterior femora armed with six to 12 rather strong teeth. General color a bright pea-green, the shrilling organ of the male brownish, with a heavy green cross-vein. The abdomen yellowish or brownish green. Specimens sometimes occur which are wholly pink or rose color.

Measurements: Male—Length of body, 21 mm.; of tegmina, 38 mm.; of posterior femora, 30 mm.; of pronotum, 6.5 mm. Female—Length of body, 23 mm.; of tegmina, 36 mm.; of posterior femora, 31 mm.; of ovipositor, 11.5 mm. Width of tegmina of male, 11.5.

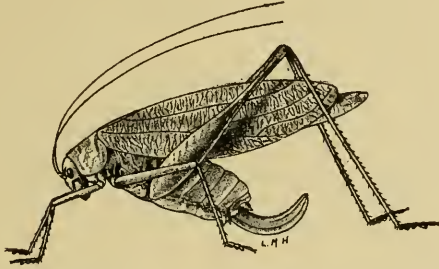


Fig. 83. *Amblycorypha oblongifolia* (DeG.) Female. (After Lugger).

The oblong-winged katydid is a common species throughout the State, its general range including the northern United States and Canada, east of the Great Plains. In southern Indiana it becomes mature about July 20th, and in the northern counties probably a fortnight later. A number of pink specimens have been taken from low meadows near Bass Lake, Starke County, by Mr. Frank Hay. Two of these are in my private collection. They were taken in a large marshy meadow in the lowlands bordering Yellow River. The causes which produce this curious "sport," by which a grass green is changed to a delicate pink, are, as yet, unknown. Scudder has said that "One thinks at once of autumn leaves and their change from green to red and notices that these pink katydids all occur in the autumn." In Indiana the pink specimens have been taken in early August, long before frost and before any noticeable change in the surrounding vegetation.

Oblongifolia frequents the shrubbery and flowers of the golden-rod and other Compositæ along fence rows and the edges of thickets and woods, especially in damp localities; and when flushed, flies with a kind of whirring noise, alighting on fence or the lower branch of tree. I have often located the male by its note, which to me is a creaking squawk—like the noise made by drawing a fine-toothed comb over a taut string. It is usually but once repeated, though sometimes three times. On several occasions it has been made after the insect was in my fingers. McNeill says that it is a "quick, shuffling noise which resembles 'katy' or 'katydid' very slightly."

85. *AMBLYCORYPHA ROTUNDIFOLIA* (Scudder). The Round-winged Katydid.

Phylloptera rotundifolia Scudder, 141, VII, 1862, 445.

Amblycorypha rotundifolia Brunner, 38, 1878, 268; Bl., 7, 1893, 105; Benth., 3, VI, 1894, 277, Plate VI, Fig. 2; Lugger 84, 1898, 222, Fig. 146; Scudd., 188, 1900, 70.

Phylloptera oblongifolia Harris, 72, 1862, Fig. 75 (Not text); Riley, 115, 1874, 169, Fig. 55 (Text in part).

The length of *A. rotundifolia* is about 32 mm. to the end of tegmina, which are proportionally much broader than those of *oblongifolia*. The posterior femora reach the tip of tegmina in the male, a little longer in the female; armed on the lower, inner carina with four or five minute teeth. Anterior margin of pronotum, especially

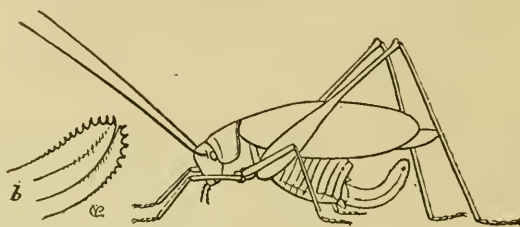


Fig. 84. *Amblycorypha rotundifolia* (Scudd.) Female. *b* Enlarged end of ovipositor. (After Riley.)

in the female, but little narrower than posterior; the hind margin of deflexed lateral lobes oblique and less broadly rounded than in *oblongifolia*. The ovipositor is more curved and more strongly serrate than in either the preceding or the following species. The color is essentially the same as that of *oblongifolia*. Pink specimens have been recorded from Pennsylvania, but they appear much more rarely than in the preceding species.

Measurements: Male—Length of body, 19 mm.; of tegmina, 27 mm.; of posterior femora, 25 mm.; of pronotum, 5 mm.; width of tegmina, 10 mm. Female—Length of body, 20 mm.; of tegmina, 27 mm.; of pronotum, 6 mm.; of ovipositor, 10 mm.; width of tegmina, 10 mm.

The round-winged katydid is also a common insect throughout Indiana, though more abundant in the southern half of the State. It is more of a terrestrial species than *oblongifolia*, being often seen on the ground, or on the clumps of tall grass and weeds, which grow in damp ravines. Its flight is comparatively noiseless and less prolonged than that of the preceding species. In southern Indiana the males become mature about the fifth of July; the females a week later. Of its note, Mr. Scudder says: "This insect stridulates both by day

and by night, and without variation. The song consists of from two to four notes—sounding like *chic-a-chee*—repeated rapidly so as to be almost confounded, and when three requiring just one-third of a second; the song is repeated at will, generally once in about five seconds, for an indefinite length of time.”

86. *AMBLYCORYPHA UHLERI* Brunner. Uhler's Katydid.

Amblycorypha uhleri Brunn., 38, 1878, 267; Bl., 7, 1893, 106; Lugg., 84, 1898, 223; Scudd., 188, 1900, 70.

Uhler's katydid is our smallest species of the genus, measuring but about 27 mm. to end of tegmina. The posterior femora are armed as in *rotundifolia*, and slightly exceed the tegmina in both sexes. Pronotum narrower in front, the anterior half of lateral carinae rounded, the posterior rather sharp; the hind margin of lateral lobes as in *rotundifolia*. The male has longer wings and narrower tegmina than the female. Ovipositor less curved than in either of the other species, the apical half with comparatively strong serrations on both margins. General color a light grass green.

Measurements: Male—Length of body, 14 mm.; of tegmina, 23 mm.; of hind femora, 20 mm.; of wings beyond tegmina, 5 mm. Female—Length of body, 17.5 mm.; of tegmina, 22 mm.; of hind femora, 23 mm.; of wings beyond tegmina, 3 mm.; of ovipositor, 8.5 mm.

This species is much less common than either of the preceding, having been taken only in Vigo County, where it frequents the tall sedges and willows bordering the large ponds in the Wabash River bottoms; and in Crawford County near Wyandotte Cave, where a number were secured, on grass and herbs. The young feed upon the leaves of the black and scarlet oaks, *Quercus velutina* Lam. and *Q. coccinea* Wang, and the perfect insect is often found on or beneath these trees. It has been recorded before from New Jersey, Maryland and the District of Columbia, and ranges southwest to Texas.

XLIII. *MICROCENTRUM* Scudder (1862).

Size, large. Wing covers moderately expanded in the middle, much longer than the posterior femora, and with the outer border sloping off quite sharply, thus causing the tip to be more pointed than in *Amblycorypha*. Vertex much as in that genus, slightly furrowed. Eyes broadly oval, very prominent. Hind legs slender and very short, the femora but little more than half as long as the tegmina. Anal plates of male not prolonged; the supra-anal bluntly rounded; the sub-anal forked at the tip as in *Amblycorypha*. Ovipositor very

short, bent abruptly upward, bluntly pointed, and with the apical third finely serrate above.

Two species occur in the United States, but one of which has, as yet, been taken in Indiana. Since the other, *M. retinerve* Burm., may in time be found in the southern half of the State, the following key will enable the student to separate the two:

KEY TO THE SPECIES OF MICROCENTRUM.

- a. General color bright green; front border of pronotum sinuate, with a slight rounded median projection; hind femora one-half the length of tegmina87 *laurifolium*, p. 354
- aa. General color yellowish green; front border of pronotum truncate, without median tooth; hind femora more than one-half the length of tegmina*retinerve*

87. MICROCENTRUM LAURIFOLIUM (L.) The Larger Angular-winged Katydid. The Oblique-winged Katydid.

Gryllus laurifolius L., 81, II, 1767, 695, 17.

Phylloptera laurifolia Burm., 40, II, 1838, 693; Serv., 196, 1839, 404.

Microcentrum laurifolium Brunn., 38, 1878, 334, 339; Bl., 7, 1893, 107; Id., 15, 1899, 215, Figs. 47, 49; Beut., 3, VI, 1894, 278, Plate VI, Fig. 3; Lugg., 84, 1898, 224, Figs. 148, 149, 150; Scudd., 188, 1900, 70.

Microcentrum affiliatum Scudd., 141, VII, 1862, 447, Fig. 5.

Microcentrus retinervis Riley, 115, 1874, 155, Figs. 43-47.

This is the largest species of "katydid" found in the State, both sexes measuring two inches and more to the tip of the wings. The general color is light, grass green, the body yellowish green, lighter beneath. The vertex is quite broad, with its center hollowed out so as to form a shallow pit, which is more prominent in the male. The pronotum is about as broad as long, its anterior margin a little sinuate and usually possessing a slight median tooth, though this is



Fig. 85. *Microcentrum laurifolium* (L.) Male. (After Riley).

sometimes obsolete, or is replaced with a shallow notch. The overlapping dorsal surface of the wing covers form a sharp and prominent angle with the lateral portions, whence the common name.

Measurements: Male—Length of body, 25 mm.; of tegmina, 42 mm.; of posterior femora, 22.5 mm.; of pronotum, 6 mm.; width of tegmina, 13 mm. Female—Length of body, 30 mm.; of tegmina, 46 mm.; of posterior femora, 24 mm.; of ovipositor, 5 mm.; width of tegmina, 14 mm.

In the country it is this insect which is most commonly called "the katydid," and the note of *Cyrtophyllus perspicillatus* L. is usually attributed to it, but its true note may be represented "by the syllable 'tic,' repeated from eight to twenty times at the rate of about four to the second." However, *M. laurifolium* is probably less common in Indiana than the broad-winged katydid, with which it is confused. I have taken it in but three counties, viz., Putnam, Vigo and Marion. It is evidently attracted by light, being occasionally found in the gutters beneath electric lights. It, perhaps, occurs throughout the State, as its general range is given as the "United States east of the Rocky Mountains," but it is nowhere in Indiana so common as to be injurious.

The eggs of *M. laurifolium* are usually glued in double rows on the sides of slender twigs, which have been previously roughened with the jaws and otherwise prepared for a place of deposit. The two rows are contiguous and the eggs of one alternate with those of the other. Those of the same row overlap about one-fourth their length. They are of a grayish brown color, long oval in shape, very flat, and measure 5.5x3 mm. They are usually deposited in September, hatch the following May, and the young, in central Indiana, reach maturity during the first half of August. These eggs have, however, been found in the State in May, and the by persons who found them on their fruit trees, and thought they were the San Jose scale or some other injurious scale insect.

Prof. C. V. Riley has written (*loc. cit.*) a pleasing description of the egg laying habits and call note of the angular-winged katydid, from which I quote at length as follows:

"The females commence to oviposit early in September, and continue to lay at intervals until the first severe frost. The eggs are occasionally deposited during the day, but the operation usually takes place at night. Selecting a twig of about the size of a common goose

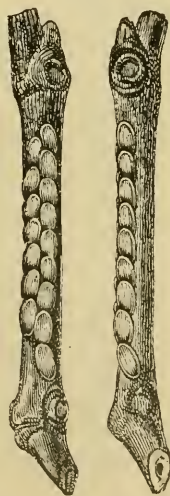


Fig. 86. Eggs of the Angular-winged Katydid. (After Riley).

quill, this provident mother prepares it for the reception of the eggs by biting and roughening the bark with her jaws for a distance of two or three inches. This bite is not gradual like that made when feeding, but is sudden and vigorous, the insect chewing and pressing the twig each side so as to form an edge. This operation is accompanied by a sudden nervous shake of the body from side to side, and lasts sometimes but two or three minutes, sometimes more than ten. When the operation is accomplished to her satisfaction, she clutches with her front feet the stem to be used, and anchors the middle and hindmost feet for the most part upon contiguous leaves or branches, and often quite wide apart. Then, if she has her head in an upward direction (for it seems to be immaterial to her whether the eggs are placed from below up or *vice versa*), she begins at the lower end of the roughened portion of the twig, and, after fretting it anew with her jaws and measuring and feeling it over again and again with her palpi, as if to assure herself that all is as it should be, she slowly—with much apparent effort, and not without letting it partly fall several times—curls the abdomen under until the lower edge of the curved ovipositor is brought between the jaws and palpi, by which it is grasped and guided to the right position. It is then worked slightly up and down for from four to six minutes—all the time guided by the jaws—while a shiny viscid fluid is given out apparently from the ovipositor. Finally, after a few seconds rest or suspension of this work, the egg gradually rises, and, as it passes between the ovipositor, turns so that the one end appears almost simultaneously, from between the convex edge, with the other from the lower tip, of the blades. The egg adheres to the roughened bark in an oblique position. It is at first almost black and highly varnished, but it acquires its normal gray color within eight or ten hours. After the egg is placed, the abdomen is straightened out and the insect rests for a few moments, soon, however, to resume her efforts and repeat the like performance, in every particular, except that the second egg is placed on the opposite side of the twig and a little above the first one. The third egg is pushed in between the top of the first one and the twig, the fourth between the top of the second, and so on, one on each side, alternately. Thus these eggs are not laid, as we might naturally imply, one over the other, but rather, one under the other; i. e., each succeeding pair having their ends thrust in between the tops of the preceding pair, the teeth at the end of the ovipositor helping to crowd the end into place.

“The length of time required from the commencement of the fretting of the twig to the proper placing of the egg varies all the

way from five to 20 minutes. Sometimes, as for instance where a bud comes in the way, the preparation of the twig will require a comparatively long time, and after the ovipositor is brought up and a futile attempt made to place the egg, it will be let down again and the work of preparing the twig more vigorously prosecuted a second time.

"The number of eggs laid at one time varies from two to 30, the first batches containing more than those deposited later in the season. Each female produces from 150 to 200, or perhaps more, and I have known them to lay on the edge of a leaf, or of a piano-cover, or along a piece of cord.

"These eggs, as already remarked, are rather flat when laid, but become more swollen, so that they have a narrower look as they approach the hatching period in spring. During the early part of May, the embryo larva—which lies straight in its egg, completely filling it, with the legs bent up as in a pupa, and the long antennæ curling around them—attains its full development, and after hours of tedious contracting and expanding movements, manages to burst the egg open at its top or exposed end, along the narrow edge, and generally about half way down. Through this opening young Katy slowly emerges, undergoing a moult during the process, and leaving its first skin, in a crumpled white mass, attached to the empty bivalvular egg shell. Including hind legs and antennæ it measures at this time, rather more than an inch in length, the body alone being one-eighth of an inch long; and in contemplating it, one can not but wonder how the long, stiff legs and great length of antennæ, together with the plump body, could so recently have been compressed into the comparatively small shell to which we see it clinging.

"In from ten to twenty minutes after hatching, these little beings essay their first leaps, and soon begin to eat with avidity. They feed with almost equal relish upon a great variety of foliage, but I have found that when reared upon very succulent leaves, such as lettuce, cabbage, purslain and the like, they are less hardy, and do not attain so great an age as when nourished upon more ligneous food, as the leaves of oak, apple or cherry.

"The first notes of this katydid are heard about the middle of July. and the species is in full song by the first of August. The wing covers are partially opened by a sudden jerk, and the notes produced by the gradual closing of the same. The song consists of a series of from 25 to 30 raspings, as of a stiff quill drawn across a coarse file. There are about five of these raspings or trills per second, all alike, and with equal intervals, except the last two or three, which.

with the closing of the wing covers, run into each other. The whole strongly recalls the slow turning of a child's wooden rattle, ending with a sudden jerk of the same; and this prolonged rattling, which is peculiar to the male, is invariably and instantly answered by a single sharp 'chirp' or 'tschick' from one or more females, who produce the sound by a sudden upward jerk of the wings.

"Both sexes are for the most part silent during the day, but during the period of their greatest activity their stridulations are never for an hour remitted, from the time the great setting sun hides behind the purple curtains of the west till he begins to shed his scarlet rays in the east—the species being so numerous that the sound as it comes from the woods is one continuous rattling, not unlike the croaking of frogs, but set to a higher key."

Sub-family PSEUDOPHYLLINÆ.

This sub-family is represented in Indiana by only one genus—characterized as follows:

XLIV. CYRTOPHYLLUS Burmeister (1838).

Tegmina broad and leaf-like, longer than the wings, obtuse and rounded at the ends, and concave or hollowed within. The vertex extends forward between the eyes in the form of a small triangular spine which is grooved above and crowded by the basal joints of the antennæ. Eyes small, globose. Prosternum armed with two short spines. Pronotum crossed by two transverse sulci; its surface rugose; its posterior third highest. Anterior pair of legs long and rather stout and well adapted for climbing. The "shrilling" organ of the male is brown in color, with the central portion as transparent as glass, and is set in a strong half-oval frame. Sub-anal plate of male produced into a long paddle-shaped appendage which is grooved on the upper side. Ovipositor of female broad, with the apical half up-curved and denticulate below; apex rather sharply pointed. One species which occurs throughout the eastern United States is common in Indiana.

88. CYRTOPHYLLUS PERSPICILLATUS (L.) The True Katydid. The Broad-winged Katydid.

Gryllus perspicillatus L., 80. 1763, 15.

Cyrtophyllus perspicillatus Burm., 40, II, 1838, 697; Brunn., 39^a, 1895, 239; Scudd., 188, 1900, 71.

Platyphyllum concavum Harris, 72, 1862, 158, Fig. 74; Riley, 115, 1874, 167, Figs. 52-54.

Cyrtophyllus concavus Scudder, 141, VII, 1862, 444; Bl., 7, 1893, 109; Id., 16, 1899, 214, Fig. 48; Beut., 3, VI, 1894, 279, Plate VI, Fig. 1; Lugger 84, 1898, 226, Figs. 151-152.

The broad-winged katydid is readily known by the characters of the genus given above. The wing covers and wings of living specimens are dark green; the body, pronotum and head lighter, with a tendency to turn yellowish when dried. The main veins of the wing

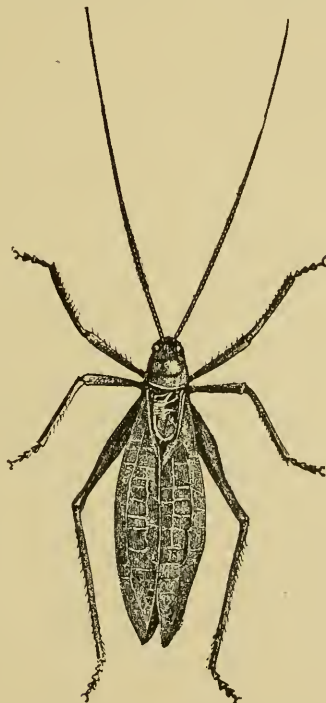


Fig. 87. *Cyrtophyllus perspicillatus* (L.) Male. (After Harris).

cover are very prominent with many reticulating branches, giving that organ much the appearance of a leaf. Posterior femora short, slender, and armed on apical half of lower outer carina with about six small spines. The ovipositor is almost as long as the abdomen, cimeter-shaped, sharp pointed, and with but slight serrations on the lower edge of apical third. The anal cerci of the male are broadly forked, and when in natural position the lower branch curves beneath the projecting sub-anal plate.

Measurements: Male—Length of body, 30 mm.; of tegmina, 37 mm.; of posterior femora, 21 mm.; of sub-anal spine, 11 mm. Width of tegmina, 18 mm. Female—Length of body, 29 mm.; of tegmina,

36 mm.; of posterior femora, 22 mm.; of ovipositor, 14 mm. Width of tegmina, 16 mm.

The broad-winged katydid is found in considerable numbers throughout the State, but is much more commonly heard than seen, as it dwells in small colonies in the densest foliage which it can find, such as the tops of shade trees and the entwining vines of the grape arbor. It is more domestic in its habits than any other species of the "katydid" group, frequenting, for the most part, the shrubbery of yards and orchards and the trees along fence rows, being seldom, if ever, heard in extensive wooded tracts. Its note is the loudest made by any member of the family, the male having the musical organ larger and better developed than in any other. The call is almost always begun soon after dusk with a single note uttered at intervals of about five seconds for a half dozen or more times. This preliminary note gives the listener the impression that the musician is tuning his instrument, preparatory to the well-known double call which is soon begun and kept up almost continuously from dark till dawn. Occasionally, in warm cloudy weather, this call is made by day; and if the musician is located he will sometimes be found resting on the topmost leaf of a shrub; swinging to and fro as the breezes blow, and sounding his cymbals in seeming unison with the movement. This katydid probably reaches maturity in southern Indiana by mid-July. The song has been heard in Putnam County as early as July 22d, and a single female was captured in Laporte County as late as October 15th.

In a Putnam County farmyard I listened for hours, one August night, to the serenade of a band of katydids. They seemingly tried to outdo themselves for my benefit. But to them I was a nonentity—an unknown being. No thought of me or of my attentive ear lurked in or passed through their brains, as they clashed their cymbals in every shrub and tree around the old farm house. One idea alone possessed the minds of the male musicians. That idea was love—passion—"that greatest thing in the universe." Long and loud the cymbals sounded, each shuffle, each note, doubtless accompanied by the wish that the next would call from the skies, from the branches above or about them—from anywhere, it mattered not—one of their form and kind. One to whom they could "whisper sweet nothings"—one whom they could caress tenderly with long antennæ—one whom, in time, they could clasp lovingly with their slender limbs and forget cymbals, calls, skies, food, earth, everything in that long embrace which to them is the acme, the one, the highest object of their mature existence.

The serenade continued thus, almost unbroken, from dusk till dawn. A serenade it was in truth—a song of love—of passion, poured out to the listening ears of the other sex. At times a single player dropped out of the chorus. His work, his love-calls had not been in vain. From some leafy retreat, where she had been hidden by day, a lady katydid slowly emerged, and, entranced by the song—by, to her ears, the tender wooing notes—drew nearer and nearer unto the charmed circle whence the cymbals clanged and shuffled. Their notes became less vigorous. More softly they fell upon her ear, until finally, as she coyly advanced they ceased and the caress of the antennæ took their place. The other musicians noted the absence of one of their chorus, and sounded their drums the louder, but for most of them their labor was in vain. Many of them doubtless go through life unblessed by the presence of the gentler sex, clanging their nightly calls from mid-July to the coming of the hoarfrost, and to its biting nips finally succumbing, possessed by the thought—if a katydid can think—that this earth is a desolate and cruel abiding place for such as they. So have the most of bachelors—human and otherwise—doubtless thought, as in the past they yielded up the ghost:

Of the call of this species Mr. Scudder has written: “The note, which sounds like *xx*, has a shocking lack of melody; the poets who have sung its praises must have heard it at the distance that lends enchantment. In close proximity the sound is excessively rasping and grating, louder and hoarser than I have heard from any other of the Locustarians in America or in Europe, and the Locustarians are the noisiest of all Orthoptera. Since these creatures are abundant wherever they occur, the noise produced by them, on an evening specially favorable to their song, is most discordant. Usually the notes are two in number, rapidly repeated at short intervals. Perhaps nine out of ten will ordinarily give this number; but occasionally a stubborn insect persists in sounding the triple note—(‘Katy-she-did’); and as katydids appear desirous of defiantly answering their neighbors in the same measure, the proximity of a treble-voiced songster demoralizes a whole neighborhood, and a curious medley results; notes from some individuals may then be heard all the while, scarcely a moment’s time intervening between their stridulations, some nearer, others at a greater distance; so that the air is filled by these noisy troubadours with an indescribably confused and grating clatter.”

According to Riley the eggs are thrust, by means of the sharp ovipositor, into crevices and soft substances, and probably, in a state of

nature, into the crevices of loose bark, or into the soft stems of woody plants. They are of a dark slate color, about 6.5x2 mm. in size, very flat, pointed at each end, and with the edges beveled off or emarginate.

Sub-family CONOCEPHALINÆ.

Vertex projecting forward and upward in the form of a tubercle or cone, sometimes blunt, sometimes much prolonged. Prosternum toothed or with two slender spines. Fore tibiæ without apical spines. Front coxæ (in our genera) with a spine on the outside. Wing covers seldom expanded in the middle, often shorter than the abdomen, and in color either green or brown. Shrilling organ of male well developed, the cross-vein prominent, the color light brown, with the central portion transparent (except in the genus *Conocephalus*). Hearing organs present near the base of fore tibiæ. Hind legs usually stout and much thickened at the base, as the insects seldom fly, but are active leapers, and very difficult to capture.

The eggs are deposited between the stems and root leaves of grass, in the pith of twigs, or sometimes in the turnip-shaped galls so common on certain species of willow. The ovipositor, being thus used as a piercer, has in time developed into a slender and sharp-pointed instrument which is but little curved and is frequently of excessive length, in some species being over twice as long as the remainder of the body.

To this sub-family belong those slender-bodied green grasshoppers, with long, tapering antennæ which are so common in summer and early autumn in damp meadows and prairies and along the margins of streams, ditches and ponds. They are mostly terrestrial in their habits, but one or two of the larger ones ever being found in trees.

The color of their bodies corresponds closely with that of the stems and leaves of the sedges and grasses among which they dwell, and so protects them from the sight of the few birds which frequent a like locality. Their songs, produced in the same manner as those of their larger cousins, the katydids, are as frequent by day as by night, but are usually soft and low in comparison with those of the former. Their day song differs from that of the night, and, says Scudder, "It is curious to observe these little creatures suddenly changing from the day to the night song at the mere passing of a cloud and returning to the old note when the sky is clear. By

imitating the two songs in the daytime the grasshoppers can be made to represent either at will; at night they have but one note.”*

This sub-family is represented in Indiana by three genera which may be separated by the following key:

KEY TO GENERA OF INDIANA CONOCEPHALINÆ.

- a.* Fore and middle femora spined beneath; vertex produced forward into a long sharp cone; stridulating organ of male green and opaqueXLV. CONOCEPHALUS, p. 363
- aa.* Fore and middle femora unarmed beneath; vertex terminating in a rounded tubercle which is hollowed out on the sides; stridulating organ of male light brown and partly transparent.
 - b.* Prosternal spines very short; ovipositor slender, straight or nearly so; insect small.....XLVI. XIPHIIDUM, p. 371
 - bb.* Prosternal spines longer and more slender; ovipositor stout, usually upcurved; insect of medium size..... XLVII. ORCHELIMUM, p. 381

XLV. CONOCEPHALUS Thunberg (1815).

THE CONE-HEADED GRASSHOPPERS.

The members of this genus are readily known by having the vertex prolonged forward and upward into a cone which much exceeds in length the first segment of the antennæ, and bears a pointed tooth beneath. Face very oblique. Eyes sub-rotund, rather prominent. Spines of prosternum long and slender. Wing covers long, narrow, rounded at the end, much exceeding the abdomen and slightly exceeding the wings in all our species. The stridulating organ of the male is opaque and of a coarse texture in the left wing cover, but transparent at the center of the right. Hind femora of moderate length, rather slender, the insects often using the wings as locomoters. Ovipositor rather narrow, nearly straight, oftentimes of excessive length; the eggs of those species in which the oviposition has been noted, being deposited between the stem and the root leaves of plants. Anal plates of male not produced; the cerci much swollen, recurved and toothed.

Although these insects are said to be rather common by those writers who have prepared lists of Orthoptera from other states, yet in Indiana they are the least abundant of all the winged *Locustidæ*, ten years' collecting having yielded less than twenty specimens. They appear to be more common in the northern than in the southern half of the State.

* American Naturalist, II, 1868, 116.

Of the habits of the species found in Illinois, McNeill has written: "All the species of *Conocephalus* seem to possess more intelligence than is usual among the Orthoptera, and they are about the most difficult of the order to approach. In escaping they usually slip or fall into the grass instead of jumping or flying; but they seem to fully understand that they are very well protected by their color and form. If approached very cautiously they often remain quite still upon the stem of grass upon which you have surprised them with the usually well founded expectation that you will not be able to distinguish them from the green herbage around. If they think it worth while to make some active movement to escape they will frequently slip around on the other side of the stem and walk down the stem to the ground or off upon another plant. Unlike most Orthoptera they do not use their front legs in holding to the mouth the thing upon which they feed. Instead of biting they seem to wrench or tear away pieces from the stems or leaves."*

The genus is a large one, 101 species being included by Redtenbacher in his monograph. Only sixteen, however, are listed by Scudder as occurring in the United States, and but five have, up to the present, been taken in Indiana. These may be distinguished by the following table:

KEY TO INDIANA SPECIES OF CONOCEPHALUS.

- a. Cone of vertex slender, extending 3 mm. or more in front of eyes, and with either the margin or lower face black.
 - b. Each margin of cone with a black line extending from the apex half way or more to base; inner, lower carina of posterior femora with four or five minute spines. *80 ensiger*, p. 365
 - bb. Lower face of cone wholly black from apex to inferior basal tooth; posterior femora armed on both the lower carinae with a number of plainly visible spines.
 - c. Length of body of female less than 36 mm.; of cone of vertex not over 4.5 mm. *90 nebrascensis*, p. 366
 - cc. Length of body of female more than 45 mm.; of cone of vertex more than 7 mm. *91 bruneri*, p. 367
- aa. Cone of vertex rather stout, extending less than 3 mm. in front of eyes, devoid of black markings.
 - d. Lateral carinae of pronotum with a yellow line; wing covers with irregularly distributed black dots; ovipositor exceeding 25 mm. in length. *92 robustus*, p. 368
 - dd. Lateral carinae of pronotum without trace of yellow; wing covers a bright grass green, immaculate; ovipositor less than 20 mm. in length. *93 palustris*, p. 369

* Psyche, VI, 23.

89. *CONOCEPHALUS ENSIGER* Harris. The Sword-bearer.

Conocephalus ensiger Harris, 72 1862, 163, Fig. 79; Riley, 122, II, 1884, 187, Fig. 263; Comstock, 41, I, 1888, 115; Redtenb., 110, 1891, 67, 89; Scudd., 168, XXIII, 1892, 72 (note of to music); Id., 188, 1900, 72; Bl., 7, 1893, 114; Beut., 3, VI, 1894, 281, Plate VI, Fig. 8; Lugger, 84, 1898, 230, Figs. 153, 154.

A slender bodied species, the general color of which is grass green (rarely brown), the body and face paler; the posterior tibiae and tip of ovipositor infuscated. Lateral carinae of pronotum sometimes with a faint yellow line, more plainly visible in the dried specimens. Tegmina very long and slender.

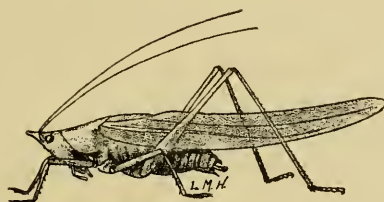


Fig. 88. *Conocephalus ensiger* Harris. Male. (After Lugger.)

Measurements: Male—Length of body, 26 mm.; tegmina, 42 mm.; of posterior femora, 21 mm. Female—Length of body, 28-30 mm.; of tegmina, 47 mm.; of posterior femora, 23 mm.; of cone of vertex, 3.25 mm.; of pronotum, 7.5 mm.; of ovipositor, 28-31 mm.

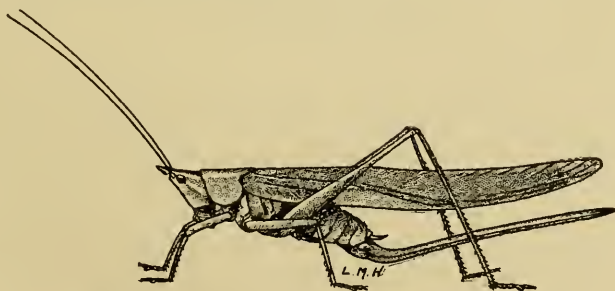


Fig. 89. *Conocephalus ensiger* Harris. Female. (After Lugger.)

Ensiger is probably the most widely distributed species of *Conocephalus* occurring in the eastern United States, having been recorded from Maine to the Rocky Mountains. It is the most common one occurring in northern Indiana, where it frequents the tall grasses along ditches and the borders of damp prairies. In the central and southern counties it is scarce, being replaced by the next species.

The female of *ensiger* has been recorded as depositing her eggs between the stem and the root leaves of *Andropogon*, a genus of tall, coarse grasses which grow in dry, sandy localities. The young, hatched in May, reach maturity in central Indiana about July 20th. Mr. Scudder, who has set the note of the male to music, says of the song: "This insect has but a single song and stridulates only by night, or during cloudy weather. It begins its song as soon as the sky is obscured or the sun is near the horizon. It commences with a note like *brw*, then pauses an instant and immediately emits a rapid succession of sounds like *chwi* at the rate of about five per second, and continues them for an unlimited time. Another writer likens its note to the syllable 'ik-ik-ik,' as if sharpening a saw, enlivening the low bushes, and particularly the cornpatch, as it seems to especially delight in perching near the top of a cornstalk and there giving forth its rather impulsive song."

90. *CONOCEPHALUS NEBRASCENSIS* Bruner. The Nebraska Cone-head.

Conocephalus nebrascensis Bruner, 25, XXIII, 1891, 72; Scudder, 168, XXIII, 1892, 72; Id., 188, 1900, 72; Bl., 7, 1893, 115; Lugg., 84, 1898, 231.

This is a heavier bodied and shorter winged species than the preceding. The cone of the vertex projects upward more strongly and has the apical half more tapering than in *ensiger*; the basal tooth is also more prominent. The anal cerci of male are stout, with strong internal hooks. Ovipositor long and slender, lanceolate, a little curved upward and extending about one-fourth of an inch beyond the closed tegmina.

General color either bright grass green or a yellowish brown or tan with narrow, yellowish lines along the lateral carinæ of the pronotum. Posterior tibiæ together with all the feet more or less infuscated.

Measurements: Male—Length of body, 28 mm.; of tegmina, 37 mm.; of pronotum, 8 mm.; of cone of vertex, 3.5 mm.; of posterior femora, 21 mm. Females—Length of body, 33 mm.; of tegmina, 42 mm.; of posterior femora, 23 mm.; of ovipositor, 29 mm.

The above measurements are very nearly the same as those given by Mr. Bruner in the original description of the species, and are the average of a half dozen specimens in my collection. I have one female, however, which is so much larger that at first I was inclined to think it a different species, but the color and structure, except the measurements, agree in every particular with those given above of *nebrascensis*. The following are the measurements of the specimen

in question: Length of body, 36 mm.; of cone, 4.5 mm.; of tegmina, 49 mm.; of posterior femora, 30 mm.; of ovipositor, 39 mm.

In central Indiana this is the most common of the three species of *Conocephalus* there occurring. A number of specimens have been taken in Putnam County by Mr. W. A. Riley, and in Vigo, Fulton and Starke counties by myself. When approached it often attempts to escape by burrowing beneath the fallen grass. It frequents the same localities as *C. ensiger* and is very liable to be mistaken for that species by the casual observer, but may at once be distinguished by the characters given in the key.

91. *CONOCEPHALUS BRUNERI* sp. nov. Bruner's Cone-head.

A large but comparatively slender bodied species, having the cone of vertex excessively long, flat rather than convex above, and with its under side a shining black as far back as the basal tooth.

General color: A light pea green tinged with yellowish on the head, pronotum and fore femora. A narrow yellowish line along the lateral carinae of pronotum, absent on the head but present on the

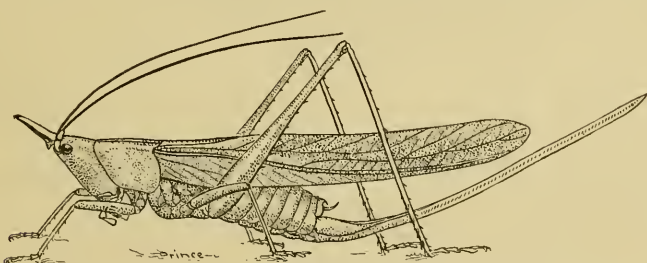


Fig. 90. *Conocephalus bruneri* sp. nov. Female. Natural size. (Original.)

lateral margins of cone of vertex. A very narrow and oblique yellowish line also extends a short distance back from each eye. Mandibles yellow. Feet and apical joints of palpi more or less infuscated.

Cone of vertex very prominent, extending 7.5 mm. in front of eyes, flattened above, with a slight median furrow in its basal half, gradually tapering from the base forward, its apical half curved slightly upward, the apex rounded and rather blunt; the lower basal tooth small and blunt. Pronotum the same length as the fore femora, of more than average breadth, the lateral carinae evident but dull, the hind margin broadly rounded; the sides flaring noticeably outward, rather than at right angles to the dorsal field as in most species, their surface a little rugose. Tegmina reaching a little beyond the middle of ovipositor, their basal third rather broad, the apical two-thirds tapering very gradually to the rounded apex. Wings equaling the

tegmina in length. Fore and middle femora short and stout, unarmed beneath, the former one-third the length of hind femora, the latter a little longer. Hind femora short but slender, armed on both margins of lower carinae with about nine small but sharp teeth, those on inner carina a little longer and more distant, one from another, than those on outer. Hind tibiae a little shorter than the femora. Ovipositor slender, of more than average length, of equal width to within 5 mm. of the apex, from whence it tapers gradually to a rather dull point.

Measurements: Female—Length of body, 44 mm.; of pronotum, 9.5 mm.; of tegmina, 50 mm.; of fore femora, 9.5 mm.; of hind femora, 30 mm.; of hind tibiae, 29 mm.; of ovipositor, 45 mm.

This large and odd appearing Locustid is represented in my collection by a single female, taken in September, 1900, by Mr. Arthur Dransfield in the campus of the "Working Men's Institute," at New Harmony, Posey County, and kindly presented to me. It is quite distinct from any other species in this country, approaching most closely the Brazilian species *C. truncatirostris* described by Redtenbacher. The fastigium of the vertex is, however, even longer than in that species. Professor Lawrence Bruner, to whom the specimen was sent for examination, writes that he has a single female of the same insect taken from the Potomac bottoms, D. C., some years ago. The male is, as yet, unknown. The species is evidently southern in its range, and should be looked for throughout southern Indiana.

I take pleasure in naming this large Locustid in honor of Prof. Lawrence Bruner, of Lincoln, Nebraska, an authority on North American Orthoptera, who has shown me many courtesies during the preparation of this paper.

92. *CONOCEPHALUS ROBUSTUS* Scudder. The Robust Cone-head.

Conocephalus robustus Scudd., 141, VII, 1862, 449; Id., 168, XXIII, 1892, 72 (song of); Id., 188, 1900, 72; Riley, 122, II, 1884, 187; Comstock, 41, I, 1888, 115; Redtenb., 110, 1891, 89, Plate III, Fig. 36; Bl., 7, 1893, 116; Bent., 3, VI, 1894, 280, Plate VI, Fig. 9; Lugg., 84, 1898, 232.

General color bright green or pale brown; sometimes a mixture of both; the wing covers usually speckled with black. Cone of vertex much like that of *C. ensiger* but shorter, with the apex more obtuse; rarely with a black spot at apex, its sides often with a narrow yellowish line; the frontal basal tooth distinct but blunt. Posterior femora armed beneath on both carinae with a number of rather weak spines. Wings of male equaling the tegmina in length, in the female a little shorter. Ovipositor shorter than in any of the preceding species.

Measurements: Male—Length of body, 30 mm.; of tegmina, 44 mm.; of hind femora, 23 mm.; of pronotum, 8 mm.; of cone, 2 mm. Female—Length of body, 31 mm.; of tegmina, 48 mm.; of hind femora, 26 mm.; of ovipositor, 26 mm.

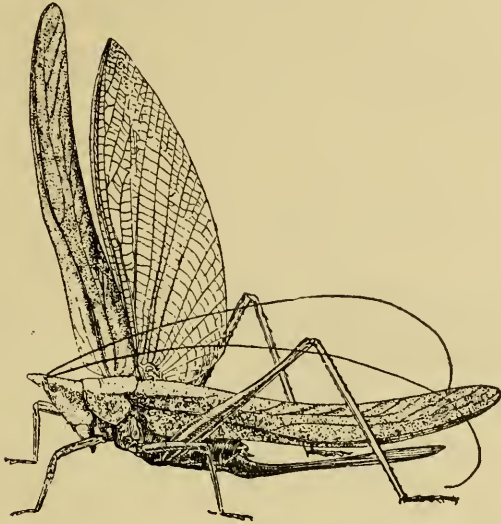


Fig. 91. *Conocephalus robustus* Scudd. Female. Natural size. (After Beutenmüller).

This species seems to be an inhabitant of sandy districts and occurs only along the Atlantic seacoast and the shores of the Great Lakes. In Indiana it has been noted only in Laporte County, where Prof. E. E. Slick found it quite frequently along the shore of Lake Michigan during September and October. Of the specimens sent to me—a half dozen males—he wrote: "They were caught off the trees, in the dusk of the evening, as they were singing. They sang ('whetted') continuously for ten minutes or longer while I watched them."

Mr. Scudder thus describes the note as heard in New England: "Robustus is exceedingly noisy and sings equally, and I believe similarly, by day and night. The song resembles that of the harvest fly, *Cicada canicularis*. It often lasts for many minutes, and seems, at a distance, to be quite uniform. On a nearer approach one can hear it swelling and decreasing in volume * * * and it is accompanied by a buzzing sound, quite audible near at hand, which resembles the humming of a bee or the droning of a bag-pipe."

93. *CONOCEPHALUS PALUSTRIS* Blatchley. The Marsh Cone-head.

Conocephalus palustris Bl., 10, XXV, 1893, 89; Id., 7, 1893, 118; Scudd., 188, 1900, 72.

A small but comparatively heavy-bodied species, having the cone of the vertex devoid of black markings and without a basal tooth; ovipositor very short and more than usually broad; posterior femora armed beneath on both carinæ. Cone of vertex short and stout, the tip round, the deflexed front with a dull median carina. Pronotum short, broad, the posterior margin regularly rounded, the lateral

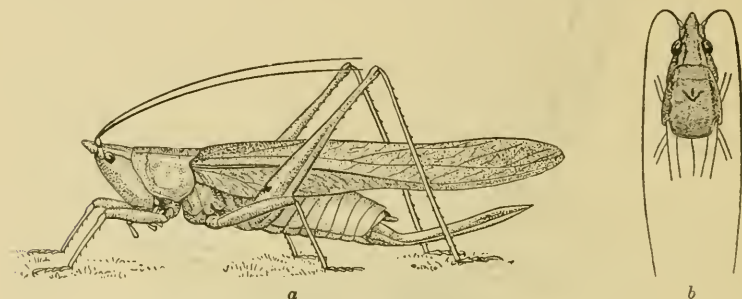


Fig. 92. *Conocephalus palustris* Bl.
(a) Female. One and one-third times natural size.
(b) Head of same from above. (Original).

carinæ well defined, the entire surface thickly and rather deeply punctate. Tegmina long and rather narrow, regularly rounded to the apex; of a more delicate texture than in either *C. ensiger* Harris or *C. robustus* Scudder. Fore and middle femora with two short spines on the apical third of the lower outer carina. Hind legs short, the tibiæ but little more than half as long as the closed tegmina; the femora with plainly visible spines on both of the inferior carinæ, eight on the outer and six on the inner. Ovipositor a little shorter than the hind tibiæ, broadest at a point about two-thirds the distance from the base, thence tapering regularly to a sharp apex.

General color a very bright grass green. Fastigium tipped with dull yellow, which extends half way down the sides. Labrum and apical segments of all the palpi a rose red tinged with violet. Tarsi somewhat infuscated. Antennæ and apical third of ovipositor reddish-brown.

Measurements: Female—Length of body, 27 mm.; cone of vertex, 2.75 mm.; of pronotum, 7 mm.; of tegmina, 37 mm.; of hind femora, 20 mm.; of hind tibiæ, 19.5 mm.; of ovipositor, 19 mm.

This handsome species of *Conocephalus* belongs to the same group as *C. robustus* and *C. crepitans* Scudder, but is smaller and of a more uniform and brighter green than either of those species, besides having shorter legs, ovipositor, etc. It is described from a single female

taken October 24, 1891, from the fallen grasses on the margins of a large lowland pond in Vigo County. This pond, now extinct, was surrounded on all sides by heavy timber, and its margins yielded a number of interesting Orthoptera found nowhere else in the county. Among them were *Leptysma marginicollis* Serv., *Paroxya hoosieri* Bl., *Anaxipha exigua* Say, *Phylloscirtus pulchellus* Uhler, and *Xiphidium nigropleura* Bruner. The first four mentioned are insects of a southern range, and perhaps *C. palustris* will, in time, be found to be more common southward.

XLVI. XIPHIDIUM Serville (1831).

This genus includes our smallest winged Locustidæ. The vertex projects forward and slightly upward in the form of a rounded tubercle which is hollowed out on the sides for the reception of the basal joint of the antennæ. Face rounded, somewhat oblique. Eyes rather large, sub-globose. Spines of prosternum very short and weak; often mere cone-shaped protuberances. Wing covers narrow, straight, rounded at the end, often varying much in length in the same species, but for the most part shorter than the abdomen. Wings usually a little shorter than the wing covers. Stridulating organ of male well developed, the veins prominent, light brown in color, and with the middle transparent. Hind femora of medium length, stout at base; mostly unarmed beneath. Ovipositor narrow, straight or but slightly curved, oftentimes of excessive length. Anal plates of male not prolonged; the cerci usually much swollen, and toothed at base on the inner margin. Eight species are known to occur in Indiana.

These insects are more variable in color and in the length of wings than those of any other genus of Orthoptera known to me. The variations, however, seem to be abrupt with no intervening forms. There are long-winged and short-winged forms of the same species but none with the wings of medium length; and when a brown form is tinged with green, or *vice versa*, the amount of the different color varies but little. Four of our eight species are thus dimorphic as regards the length of the wings, the short-winged individuals, as far as my observation goes, far outnumbering those with the wings fully developed; and at least three of the eight are variable with respect to color.

KEY TO INDIANA SPECIES OF XIPHIDIUM.

a. Ovipositor shorter than the body.

b. Ovipositor straight.

c. Body very slender; wings a little longer than the tegmina; the latter always fully developed and longer than abdomen94 *fasciatum*, p. 372

- cc. Body stouter; wings in the common form shorter than the tegmina; the latter usually abbreviated, not reaching tip of abdomen.....95 *brevipennis*, p. 373
- bb. Ovipositor a little curved; tegmina constant in length, covering about two-thirds of the abdomen in the male; shorter in the female96 *nemorale*, p. 374
- aa. Ovipositor equal to or longer than the body.
- d. Length of posterior femora almost equal to that of the ovipositor.
- e. Body rather stout; the tegmina always covering more than half the abdomen.
- f. Abdomen with dorsal surface light brown, the sides green, or yellowish green; ovipositor no longer than body97 *ensiferum*, p. 375
- ff. Abdomen with the dorsal surface a fuscous brown, the sides shining black; ovipositor plainly longer than body98 *nigropleura*, p. 376
- ec. Body very slender; the tegmina exceedingly short, pad-like, covering only one-third of abdomen, the sides of latter dull reddish brown.....99 *saltans*, p. 377
- dd. Posterior femora much shorter than the ovipositor, the latter of excessive length.
- g. Under side of hind femora unarmed; the sides of the body green100 *strictum*, p. 378
- gg. Under side of hind femora armed on the outer carina with several short black spines; the sides of the body dull reddish brown.....101 *attenuatum*, p. 379
94. *XIPHIDIUM FASCIATUM* (DeGeer). The Slender Meadow Grasshopper. *Locusta fasciata* DeG., 57, III, 1778, 458, Plate XL, Fig. 4.
Xiphidium fasciatum Burm., 40, II, 1839, 708; Pack., 104, 1883, 567; Riley, 122, II, 1884, 186; Comst., 41, I, 1888, 114; Redtenb., 110, 1891, 192, Plate IV, Fig. 82; Scudd., 168, XXIII, 1892, 75 (song of); Id., 183, XXX, 1898, 184; Id., 188, 1900, 74; Brun., 27, III, 1892, 265; Bl., 7, 1893, 119; Beut., 3, VI, 1894, 283, Plate VI, Fig. 7; Lugg., 84, 1898, 238, Figs. 157, 158.

Fasciatum is one of the most slender bodied Locustids belonging to our fauna. It is the only species of Indiana *Xiphidium* whose wings are never shorter than the body. Posterior femora reaching to or slightly beyond the tip of tegmina in the female, distinctly shorter in the male. Face, sides of pronotum and abdomen, and basal portion of ovipositor green; tegmina and apical third of ovipositor light reddish brown; upper side of abdomen, and stripe on occiput and disk of pronotum darker brown; legs green, brownish on the knees and tarsi.

Measurements: Male—Length of body, 13.5 mm.; of tegmina, 17.5 mm.; of hind femora, 11.5 mm.; of pronotum, 3.5 mm. Female

—Length of body, 14 mm.; of tegmina, 16 mm.; of hind femora, 13 mm.; of ovipositor, 8 mm.

This handsome meadow grasshopper is abundant throughout the State in timothy and clover meadows and especially so about small streams in low ground, blue-grass pastures. It is one of the first of the Locustidæ to reach maturity, specimens having been taken in Vigo County as early as July 5th, and it may be found until mid-October. The note of the male is very faint—a kind of *zr-r-r-r* long drawn out.

Fasciatum has, perhaps, the widest distribution of any of our American Locustidæ, its range, according to Redtenbacher, being from British America to Buenos Ayres, S. A.

The *Orchelimum gracile* of Harris, usually quoted as a synonym of *X. fasciatum*, has been shown by Bruner (*loc. cit.*) to be a distinct and valid species.

95. *XIPHIDIUM BREVIPENNE* Scudder. The Short-winged Meadow Grasshopper.

Xiphidium brevipennis Scudd., 141, VII, 1862, 451; Bent., 3, VI, 1894, 283, Plate VI, Fig. 6.

Xiphidium brevipenne Scudd., 148, 1874, 368; Id., 183, XXX, 1898, 184; Id., 188, 1900, 74; Riley, 122, II, 1884, 186; Comst., 41, I, 1888, 114; Redtenb., 110, 1891, 206, Plate IV, Fig. 91; Bl., 7, 1893, 121; Lugg., 84, 1898, 239.

A little shorter and thicker bodied species than *X. fasciatum*. Posterior femora rather short and stout, unarmed beneath, or rarely with one to four minute spines. Cerci of male swollen, the apex strongly compressed and obtuse, armed below the middle with a rather flat, sharp pointed tooth.

General color: Light reddish brown; the face and sides of pronotum usually green; stripe on occiput and disk of pronotum a very dark brown, margined on each side with a narrow yellow line; tegmina and wings a light reddish brown; ovipositor reddish brown throughout, darker toward the apex.

Measurements: Male—Length of body, 11 mm.; of tegmina, 7 mm.; of posterior femora, 10 mm.; of pronotum, 3 mm. Female—Length of body, 11-13 mm.; of tegmina, short winged form, 7 mm.; of posterior femora, 11 mm.; of pronotum, 3 mm.; of ovipositor, 10 mm.

This is also an abundant species throughout the State, frequenting the same localities as *fasciatum* and reaching maturity about a fort-



Fig. 93. *Xiphidium brevipenne* Scudd
Female. Natural size. (After Beutenmüller.)

night later. Long winged forms of *brevipenne* occasionally occur, but in Indiana they are very scarce, but one or two having come under my notice. Of the variations in the length of the wing covers of it and allied species, Professor Bruner has well said: "That in the genera *Xiphidium* and *Orchelimum* wing length is a character not to be relied upon as specific or even varietal difference;" yet Redtenbacher, in his "Monographie der Conocephaliden," has separated a number of his species by this character alone, and I can find no mention in his work of the fact that such a variation exists.

96. *XIPHIDIUM NEMORALE* Scudder.

Xiphidium nemorale Scudd., 151, XVII, 1875, 462; Id., 153, IV, 1875, 65; Id., 164, 1879, 15; Id., 168, XXIII, 1892, 75 (song of); Id., 183, XXX, 1898, 184; Id., 188, 1900, 75; Bl., 7, 1893, 122; Bent., 3, VI, 1894, 284; Lugg., 84, 1898, 240.

Xiphidium curtipenne Redtenb., 110, 1891, 208.

A rather robust species with the general color a dark, greenish brown; tegmina light reddish brown with the front or lower area fuscous. Dorsal stripe of occiput and pronotum a lighter grayish brown margined with a narrow yellowish line on each side. All the femora punctate with reddish dots, the tarsi and tip of hind femora dusky. Tegmina with the veins and cross-veins unusually prominent, giving them a coarse and scabrous look; the tympanum of male stout and elevated. Cerci conical, the apex obtuse, but little compressed. Ovipositor as long as the abdomen, the apical half with a gentle but evident upward curve.

Measurements: Male—Length of body, 14 mm.; of tegmina, 8 mm.; of hind femora, 12 mm.; of pronotum, 3.5 mm. Female—Length of body, 15 mm.; of tegmina, 5.5 mm.; of hind femora, 13 mm.; of ovipositor, 9 mm.

Nemorale is a common insect in central and southern Indiana, but has not as yet been taken north of Marion and Wells counties. It reaches maturity about August 1st, and from then until after heavy frosts may be found in numbers along the borders of dry, upland woods, fence rows, and roadsides, where it delights to rest on the low shrubs, blackberry bushes, or coarse weeds usually growing in such localities. On sunny afternoons of mid-autumn it is especially abundant on the lower parts of the rail and board fences, the male uttering his faint and monotonous love call—a sort of *ch-e-e-e-e—ch-e-e-e-e*, continuously repeated—the female but a short distance away, a motionless, patient, and apparently attentive listener. When in *coitu* the male does not mount the back of the female, but, with his body reversed, is dragged about by her, this being the com-

mon practice of all the species of *Xiphidium* and *Orchelimum*. The females at times evidently oviposit in decaying wood, as on several occasions I have found them on old fence posts and rails with their ovipositors inserted the full length in the wood.

Nemorale has been recorded from Nebraska, Iowa, Illinois and New York, and seems to be confined to the northern half of the middle United States.

97. *XIPHIDIUM ENSIFERUM* Scudder.

Xiphidium ensifer Scudd., 141, VII, 1862, 451.

Xiphidium ensiferum Scudd., 166, 1880, Appen., II, 23; Id., 183, XXX, 1898, 183; Id., 188, 1900, 74; Riley, 122, II, 1884, 186; Comst., 41, I, 1888, 114; Wheel., 223, II, 1890, 222 (oviposition of); Redtenb., 110, 1891, 209; Bl., 7, 1893, 123; Lugg., 84, 1898, 240.

Very similar in general appearance to *X. brevipenne* Scudder, and may be only a large variety of that species. Typical examples are larger, with a longer ovipositor, which is equal in length to the body and equals or slightly exceeds the length of hind femora. Tegmina of the common short-winged form covering about two-thirds of the abdomen in the female; usually reaching its tip in the male. Hind femora usually unarmed, though sometimes bearing one to four small teeth on their lower outer carina. Cerci of male rather stout, with the apical half curved slightly outward and depressed. Ovipositor slender, straight.

The general color is more of a green than in *brevipenne*; the face, sides of pronotum and abdomen, and usually the four anterior femora, being of that hue. The tegmina and wings are light reddish brown, as are also the tibiae and ovipositor.

Measurements: Male—Length of body, 12.5 mm.; of tegmina, 10 mm.; of hind femora, 13 mm.; of pronotum; 3.5 mm. Female—Length of body, 12-14 mm.; of tegmina, short winged, 8.5 mm.; long winged, 14 mm.; of hind femora, 13.5 mm.; of ovipositor, 12-14 mm.

Although found in Indiana wherever collections have been made, this species appears to be less common than either *fasciatum* or *brevipenne*. It differs from them occasionally in the manner of oviposition, as, instead of always depositing its eggs in the stems of grasses, it sometimes seeks the turnip-shaped galls so common on certain species of *Salix* (willow), and oviposits between their scales. The gall is not formed by the Locustid, but by a Dipterous insect belonging to the family of *Cecidomyidæ*. Although I have never seen the eggs deposited I have on a number of occasions found them within the galls, but did not know to what insect they belonged until

Mr. Wheeler published (*loc. cit.*) his excellent account of the oviposition of this species. From that I quote as follows: "On September 8th I observed a female in the act of oviposition. She was perched with her head turned toward the apex of the gall. Slowly and sedately she thrust her sword-like ovipositor down between the leaves, and, after depositing an egg, as slowly withdrew the organ in order to recommence the same operation, after taking a few steps to one side of where she had been at work. She soon observed me and slipped away without completing her task. The number of eggs found in a gall varies considerably. Sometimes but two or three will be found, more frequently from 50 to 100. In one small gall I counted 170." The egg is cream-colored, very thin, elongate oval in outline, and measures 4x1 mm.* The young emerge about the middle of May and reach maturity about August 10th. Long winged forms of this species are occasionally met with.

Ensiferum was first described from Illinois, and, as yet, has not been recorded east of the Alleghany Mountains. One which was still in the nymph stage on October 21st, was found to have a white hairworm (*Gordius sp?*) eight and a half inches long in its abdomen. The development of the nymph had probably been retarded by the presence of the parasite.

38. *XIPHIDIUM NIGROPLEURA* Bruner. The Black-sided Grasshopper.

Xiphidium nigropleurum Bruner, 25, XXIII, 1891, 58; Bl., 7, 1893, 125; Lugg., 84, 1898, 241.

Xiphidium nigropleura Scudd., 183, XXX, 1898, 184; Id., 188, 1900, 75.

A medium sized, rather robust species, easily distinguished from all others of the genus by its peculiar coloration. In Indiana dimorphic forms occur; one having the pronotum, tegmina and legs bright grass green, the other with these parts brownish yellow, the green wholly absent. Both forms have the stripe on the occiput and the sides of the abdomen shining black; the former narrowing in front to the width of the tubercle, and bordered on each side with yellowish white. In the green forms the usual brown stripe on the disk of pronotum is but faintly defined, in the other it is very evident.

The tegmina are usually abbreviated, reaching only four-fifths of the length of the abdomen, but an occasional specimen is to be found in which they are fully developed and then reach beyond the middle

* Mr. B. D. Walsh, in the Proc. Ent. Soc. Phil., III, 1864, 232, recorded the finding, on numerous occasions, of the eggs of an *Orchelimum* in the turnip-shaped galls of *Salix cordata*. Their shape and proportional dimensions, as given by him, differ much from those of *X. ensiferum*, as they were cylindrical, .16 to .17 of an inch long, and seven times as long as wide.

of the ovipositor in the female. Ovipositor straight, quite broad and heavy. Male cerci of medium length, rather stout, tapering gently toward the apex, and with a strong sub-basal tooth.

Measurements: Male—Length of body, 14 mm.; of tegmina, 9 mm.; of hind femora, 13.5; of pronotum, 3.5. Female—Length of body, 15 mm.; of tegmina, short-winged form, 8.5 mm.; of tegmina, long-winged form, 17 mm.; of hind femora, 14 mm.; of ovipositor, 16 mm.

In Indiana this handsome insect has been taken in Gibson, Vigo, Fulton, Marshall, Starke, Lake, Kosciusko, Wells and Steuben counties, and probably occurs in suitable localities throughout the State. It appears to be a semi-aquatic species, inhabiting only the margins of ditches, large ponds and lakes, where it abides in the tall, rank grasses and sedges growing in the shade. It reaches the perfect stage about July 1st in southern Indiana, and in Fulton County has been taken as late as October 24th. The males leap actively when approached. The females are more clumsy and usually dive head-long into a bunch of fallen grass. They can then be most readily captured by clasping the hand about a bunch of grass stems or branches of shrubs, on the under side of which the insects have taken refuge.

Nigropleura has been recorded only from Iowa, Nebraska and Ithaca, New York, specimens having been sent me from the latter locality by one of my correspondents, thus extending eastward its known habitat by more than 700 miles.

Of its habits in Nebraska, Bruner (*loc. cit.*), has written as follows: "It is quite plentiful among the rank vegetation on low moist ground, and is especially common in wet places where the "cut grass" (*Leersia oryzoides* Swartz) grows. The supposition is that this grass offers a better place than usual for the deposition of its eggs, which are deposited between the leaves and stems of grass. Grapevines and other creeping plants which form matted clusters that afford shelter from the noonday sun and the bright light of day are favorite haunts of this and other species of our nocturnal grass-hoppers and a few of the arboreal crickets."

99. *XIPHIDIUM SALTANS* Scudder.

Xiphidium saltans Scudd., 147, 1872, 249; Id., 183, XXX, 1898, 184; Id., 188, 1900, 75.

Xiphidium modestum Brun., 25, XXIII, 1891, 56; Bl., 7, 1893, 126.

This is the smallest and most slender-bodied Locustid found in the State. It is a dull, reddish brown in color, except the stripe on the

occiput and disk of pronotum, which is a dark, chocolate-brown, the two colors being separated by a rather wide yellowish line which in living specimens is very distinct.

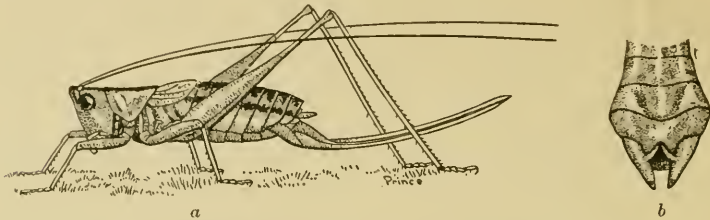


Fig. 94. *Xiphidium saltans* Scudder.

(a) Female. Two and one-half times natural size.

(b) Tip of male abdomen, showing form of cerci. (Original.)

The cone of the vertex is short and rather narrow. Tegmina, especially those of the female, very short and obtusely rounded. The shrilling organ of the male is narrower and farther removed from the base of the wing cover than in the male of *X. strictum*, its nearest ally. The tip of male abdomen is but slightly enlarged, cerci elongate, tapering, a little curved outward and armed with a rather long sub-basal tooth. Ovipositor equaling the body in length, very slender and tapering, with its apical half slightly upcurved.

Measurements: Male—Length of body, 10 mm.; of tegmina, 3 mm.; of hind femora, 9 mm.; of pronotum, 3 mm. Female—Length of body, 11 mm.; of tegmina, 2.5 mm.; of hind femora, 9.5 mm.; of ovipositor, 11 mm.

Saltans as yet has been noted only at one point in the State, namely, the border of a raw prairie near Heckland, Vigo County, where it was found in small numbers on October 21, 1893, and in September, 1894. It appears to be less active than any other *Xiphidium*, leaping a shorter distance when disturbed, and frequenting the surface of the ground rather than the stems of the tall prairie grasses among which it makes its home. It will probably be found, by close search, to inhabit most of the few remaining patches of raw prairie in the western part of the State. However, it has not been noted elsewhere than in Vigo County, east of the Mississippi River, although it is said by Bruner to be very plentiful in Nebraska, Iowa and Kansas.

100. *XIPHIDIUM STRICTUM* Scudder.

Xiphidium strictum, Scudd., 151, XVII, 1875, 460; Id., 153, IV, 1875, 63; Id., 164, 1879, 13; Id., 183, XXX, 1898, 183; Id., 188, 1900, 75; Redtenb., 110, 1891, 205; Bl., 7, 1893, 127; Lagg., 84, 1898, 242.

In this species the body is rather slender and of more than average length; constant in color but dimorphic as respects the length of wings, the long-winged forms, however, being very scarce. Sides of head and body, together with all the femora, green. The usual reddish brown stripe on occiput and pronotum narrowly edged with whitish, especially on the fastigium of the vertex. Tegmina reddish brown; in the females exceedingly short and pad-like, or well developed and reaching almost to knees; when the former, a little longer than the wings, when the latter, 5 mm. shorter than the wings. In the short-winged males (the only ones I have seen) the tegmina are somewhat less than half the length of the abdomen. There is a reddish brown band on dorsal surface of abdomen, darker where it meets the green on sides. Ovipositor pale red, straight, one and a half times the length of the posterior femora. Cerci of male, long, the apical half acuminate, curved slightly inward near the tip.

Measurements: Male—Length of body, 14 mm.; of tegmina, 5.5 mm.; of pronotum, 3.5 mm.; of hind femora, 13.5 mm. Female—Length of body, 17 mm.; of tegmina, short-winged form, 3.5 mm.; long-winged form, 16 mm.; of hind femora, 15.5 mm.; of ovipositor, 23 mm.

Strictum is a common species in the western and northern parts of the State, where it frequents, for the most part, dry upland meadows, open pastures and prairies, and reaches maturity about August 1st. The mature females are usually much more abundant than the males and vary much in size. It is an active leaper and tumbler and like several of its allies, often strives to escape detection by burrowing beneath fallen weeds and grasses. The general range of *strictum* is to the west and southwest, it having been first described from Texas, and not heretofore recorded east of Illinois, except in my former paper on Indiana Locustidæ.

101. *XIPHIDIUM ATTENUATUM* Scudder. The Lance-tailed Grasshopper.

Xiphidium attenuatum Scudd., 146, II, 1869, 305; Id., 183, XXX, 1898, 183; Id., 188, 1900, 74; Brun., 25, XXIII, 1891, 57; Id., 27, III, 1892, 265; Redtenb., 110, 1891, 191; Bl., 7, 1893, 128; Id., 16, 1899, 219, Fig. 51. (Long winged form).

Xiphidium scudderi Bl., 5^a, XXIV, 1892, 26; Scudd., 183, XXX, 1898, 183; Id., 188, 1900, 75. (Short-winged form).

General color a dull testaceous or reddish brown, in some specimens tinged with greenish. Antennæ with the basal third reddish, the remainder fuscous, longer than in any other member of the genus belonging to our fauna, measuring 73 mm. in one specimen at hand. Tegmina and wings either abbreviated or fully developed;

when the former covering about three-fourths of the abdomen in the female and reaching or slightly surpassing its tip in the male; when developed, fully twice the length of abdomen; the wings extending 4 mm. beyond the tegmina. Femora greenish brown, very rarely bright green, the tibiae and tarsi darker. Abdomen tapering but slightly posteriorly, with the base of ovipositor but little enlarged. Posterior femora heavy on their basal two-fifths, slender beyond, armed on their lower outer carina with two to four minute blackish

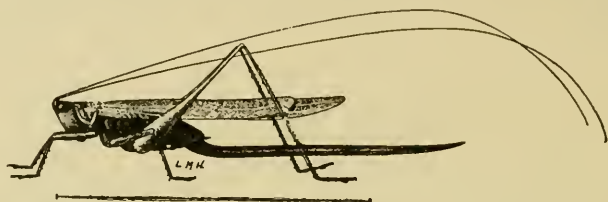


Fig. 95. *Xiphidium attenuatum* Scudd. Female. (After Lugger.)

spines. Cerci of male long, broad, with the apical third gently tapering, the basal tooth minute, slender. Ovipositor excessively long, slender, straight or but gently curved, the apex very acuminate.

Measurements: Male—Length of body, 12-15 mm.; of antennae, 73 mm.; of pronotum, 2.6 mm.; of tegmina, short winged form, 8.5 mm.; of long winged form, 19 mm.; of hind femora, 14 mm. Female—Length of body, 13-16 mm.; of pronotum, 3 mm.; of tegmina, short winged form, 10 mm.; long winged form, 19 mm.; of hind femora, 14 mm.; of ovipositor, 26-30 mm.

The short winged form of this species has proven much more abundant locally in Indiana than the long winged form. In Vigo County it was, ten years ago, very plentiful about the borders of two large ponds in the Wabash River bottoms. In Knox County a few specimens were secured in 1901 from the margin of a similar pond bordering a large cypress swamp, while in Kosciusko County it was found to be quite common in some marshes near Tippecanoe and Turkey lakes. In all these places the insects dwell among the tall rank grasses and rushes growing in shallow water. The males are, as far as my experience goes, the most active leapers among the winged Locustidae, jumping a half dozen or more times without pause when flushed, and in the net leaping so rapidly from side to side as to prevent capture with the fingers. The females are evidently handicapped in their leaping powers by the excessive length of the ovipositor, and so more often endeavor to escape by burrowing beneath the dense masses of fallen grass and reed stems which are always found in their accustomed haunts.

The long winged form was first taken in Indiana in August, 1902, when it was found in some extensive low ground meadows in Kosciusko County. Here the long and short winged forms were about equally abundant. The former flew readily when approached, but to no great distance. A few of the long winged ones were also taken near Bass Lake, Starke County. The specimens from these northern counties are more slender bodied than those from the south, where only the short winged form has been found. *Attenuatum* was first described from Illinois, though it is not mentioned in McNeill's "List of Orthoptera of Illinois." Outside of Indiana it has been recorded from Nebraska, Iowa and Minnesota.

I find that the length of the ovipositor among the different species of *Xiphidium* is not at all dependent upon the age of the insect. In both *attenuatum* and *scudderi* it is almost as long after the third, and fully as long after the fourth moult as it is in the adult; while a female of *strictum* has been taken, with no vestige of tegmina, in which the ovipositor measured 18 mm. The eggs of *attenuatum*, as the length of the ovipositor indicates, are laid between the stems and leaves of tall rank grasses among which the insects live.

XLVII. ORCHELIMUM Serville (1831).

Locustidæ of medium size, but with a short and stout body. Vertex, face and eyes much as in *Xiphidium*. Spines of the prosternum well developed, cylindrical and slender. Antennæ slender and tapering, usually of excessive length. Wing covers narrow, the apical half often much less in width than the basal, exceeding the abdomen in all our species; almost always shorter than the wings. Stridulating organ of the male as in *Xiphidium*, but proportionally larger. Ovipositor stout, broad, with the apical half usually upcurved; when straight the apical third tapers rather abruptly on the under side to a fine point. Anal plates and cerci of males as in *Xiphidium*.

This genus is very close to *Xiphidium*, and is, by some writers, united with it. Redtenbacher places it as a sub-genus of *Xiphidium*, separating its members from those of *Xiphidium* proper by the same characters as did Serville. As scientists differ in opinion as to what characters are necessary to constitute a genus, and as, at best, it is but an artificial and arbitrary grouping of species for the sake of convenience, I follow Serville, Seudder and Bruner in separating the two, believing that the prime idea of convenience can thus be better subserved.

As noted in the Key to the Genera of *Conocephalinae*, the larger, heavier body, longer prosternal spines, and shorter and broader falcate ovipositor are the chief distinguishing characters of *Orchelimum*. The wing covers are more uniform in length, and the color, while of slightly different shades of brown or green in the same species, according to season and habitat, does not run to the extremes of variation as in *Xiphidium*.

The generic name, *Orchelimum*, the literal meaning of which is "I dance in the meadows," is a most appropriate one, for low, moist meadows everywhere swarm with these insects from July to November; and though waltzes and quadrilles are probably not indulged in, yet the music and song, the wooing and love-making which are the natural accompaniments of those amusements, are ever present, and make the short season of mature life of the participants a seemingly happy one.

Eight species of the genus have been taken by the writer within the State. These may be separated by means of the following key:

KEY TO THE INDIANA SPECIES OF ORCHELIMUM.

- a. Ovipositor with a very evident curve, its length less than 10 mm.
 - b. Face without a median brown stripe.
 - c. Hind femora not armed with small spines on the under side.
 - d. Tegmina broadest at base; the apical third narrower; body robust.
 - e. Tegmina and wings sub-equal in length; not much exceeding the hind femora; size, medium.
 - 102 *vulgare*, p. 383
 - ee. Tegmina distinctly shorter than wings; plainly exceeding the hind femora; size, large.
 - 103 *glaberrimum*, p. 385
 - dd. Tegmina of nearly equal width throughout; body slender; size, small. 104 *campestre*, p. 386
 - cc. Apical half of posterior femora armed beneath with several small spines; all the tibiae and tarsi black or dark brown 105 *nigripes*, p. 387
 - bb. Face with a dark reddish brown stripe down the center.
 - 106 *indianense*, p. 388
- aa. Ovipositor straight or nearly so; its length 10 or more mm.
 - f. Posterior femora unarmed beneath.
 - g. Body slender; pronotum short, not more than 4 mm. in length; tegmina narrow, shorter than the wings.
 - 107 *delicatum*, p. 389
 - gg. Body stout; pronotum 5 or more mm. in length; tegmina and wings sub-equal in length. 108 *gladiator*, p. 390
 - ff. Posterior femora armed on the outer lower carina with several small spines 109 *volantum*, p. 390

102. *ORCHELIMUM VULGARE* Harris. The Common Meadow Grasshopper.
Orchelimum vulgare Harris, 72, 1862, 162, Fig. 77; Scudd., 142, II, 1868, 117 (note of set to music); Id., 168, XXIII, 1892, 73 (note of set to music); Pack., 104, 1883, 567; Riley, 122, II, 1884, 187; Comst., 41, I, 1888, 114; Bl. 7, 1893, 130; Id., 16, 1899, 220, Fig. 52; Beut., 3, VI, 1894, 282, Plate VI, Figs. 4 and 5; Lugg., 84, 1898, 234, Figs. 155, 156; McNeill, 90, XXXII, 1900, 78, 81.
Xiphidium agile Redtenb., 110, 1891, 186. (In part.)
Orchelimum agile Scudd., 188, 1900, 73.

A medium sized, robust species, with the general color green or light reddish brown. Face light green or light brown without fuscous marks. The occiput and disk of pronotum with a reddish brown band, widening on the latter, where it is often, especially in the male, bordered on each side with a darker line. The male (as in most of our species) with two short, black dashes on each wing cover, the four forming the angles of an assumed square, enclosing the tympanum. The legs usually pale brown, the tarsi dusky. Pronotum

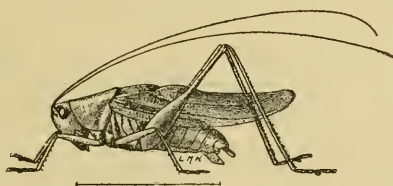


Fig. 96. *Orchelimum vulgare* Harris. Male. (After Lugg.)

long, its posterior lobe but slightly, if at all, upturned above the plane of the anterior, its hind margin broadly rounded. Tegmina reaching to or very slightly beyond the apex of hind femora, and equaling or very little shorter than the wings. Cerci of male rather long, the apex bluntly rounded, a little depressed; sub-basal tooth somewhat flattened, with the tip sharp and decurved.

Measurements: Male—Length of body, 18 mm.; of pronotum, 6 mm.; of tegmina, 21 mm.; of hind femora, 17 mm. Female—Length of body, 19 mm.; of pronotum, 6.2 mm.; of tegmina, 21 mm.; of hind femora, 18 mm.; of ovipositor, 7.5 mm.

This meadow grasshopper is probably the most abundant member of the family Locustidæ found in Indiana. It begins to reach maturity in the central part of the State about July 10th, and more frequently than any other of our species of *Orchelimum* it is found in upland localities, along fence rows, and in clover and timothy meadows. In early autumn it seems to be very fond of resting on

the leaves and stems of the ironweed, *Vernonia fasciculata* Michx., so common in many blue-grass pastures.

"The poetry of earth is never dead:
When all the birds are faint with the hot sun,
And hide in cooling trees, a voice will run
From hedge to hedge about the new mown mead;
That is the grasshopper's—he takes the lead
In summer luxury, he has never done
With his delights; for when tired out with fun
He rests at ease beneath some pleasant weed."

Vulgare seems to be somewhat carnivorous in habit, as, on two occasions, I have discovered it feeding upon the bodies of small moths which in some way it had managed to capture; while on another date I surprised a female on the flowers of a golden-rod, feasting upon a soldier beetle, *Chauliognathus pennsylvanicus* DeG.

Of the call note of the male *vulgare* Scudder has written: "When about to sing on a hot, sunny day, the male mounts a stalk of grass to about a foot from the ground where it clings with its four front legs, allowing its hind legs to dangle on either side of the stalk that they may not interfere with the movements of the tegmina. Beginning with *ts* it changes almost instantly to a trill of *zr*; at first there is a crescendo movement which reaches its volume in half a second; the trill is then sustained for a period varying from one to twenty seconds (generally from six to eight seconds), and closes abruptly with *p*. This strain is followed by a series of very short staccato notes sounding like *jip, jip, jip*, repeated at half second intervals; the staccato notes and the trill alternate *ad libitum*. The staccato notes may be continued almost indefinitely, but are very rarely heard more than ten times in direct succession; it ordinarily occurs three or four times before the repetition of the phrase, but not more than two or three times when the phrase is not repeated. The night song differs from that of the day in the rarer occurrence of the intermediate notes and the less rapid trill of the phrase; the pitch of both is at B flat."

Redtenbacher places *vulgare* as a synonym of DeGeer's *Xiphidium agile*, stating as his reason for so doing that Harris and Scudder have separated the two "on account of small differences in the color and size of the wing covers, as well as in the length of the ovipositor." He may be right in thus combining them, but his relative measurements of *X. agile* as given, do not agree with the specimens of undoubted *vulgare* in my possession. Scudder, who has had ample opportunity to compare the two, says (Bost. Journ. Nat. Hist. VII

453) that the pronotum is shorter in *agile* than in *vulgare*. Redtenbacher's measurements of this organ, as well as those of the hind femora, are much less than the average measurements given above. Harris, as well as Burmeister, states that the tegmina of *agile* are 2.5 mm. shorter than the wings, while McNeill (*loc. cit.*) says that *agile* has the hind femora armed beneath. Taking all these facts into consideration, though having no typical examples of *agile* for comparison, I have concluded not to follow Redtenbacher but to retain for the species at hand the name *vulgare*, by which it is best known to the entomologists of the United States.

103. ORCHELIMUM GLABERRIMUM (Burmeister).

Xiphidium glaberrimum Burm., 40, II, 1838, 707; Redtenb., 110, 1891, 187.

Orchelimum glaberrimum Scudd., 141, VII, 1862, 453; Id., 188, 1900, 73; Riley, 122, II, 1884, 186; Comst., 41, I, 1888, 114; Bl., 7, 1893, 133; Lugg., 84, 1898, 235; McNeill, 90, XXXII, 1900, 78, 81.

Very close to and perhaps only a larger form of *O. vulgare*. The general color is the same, but the brown line on the disk of pronotum is, in the female, more plainly margined with black, while in the male the black dashes at ends of tympanum are larger and more completely enclose that organ. The tegmina of the male exceed the hind femora by about 4 mm., and are exceeded by the wings about the same distance; those of the female are proportionally a little shorter.

Measurements: Male—Length of body, 22 mm.; of pronotum, 6 mm.; of tegmina, 26 mm.; of hind femora, 19 mm. Female—Length of body, 23 mm.; of pronotum, 6.5 mm.; of tegmina, 24-27 mm.; of hind femora, 20 mm.; of ovipositor, 8.5 mm.

Burmeister's original description of this species is very short and not distinctive. It is as follows: "Verticis et pronoti medio fulvo, nigro-marginato; elytris ab alis dimidia linea superatis. Long. corp., 11'''." Burmeister knew but two species from the United States, and this short description was sufficient for him to distinguish these, but of the twenty or more species now known it is difficult to say just which one he had in mind when he wrote the above.

Glaberrimum is not a common species in Indiana. I have taken it in Vigo, Fulton, Marshall and Starke counties, but only one or two examples from each locality. All were secured from tall grass growing near the margins of ponds or lakes. It is evidently attracted by electric and other lights, as Dr. Robert Hessler took one from his office window near the center of the city of Logansport on the night

of August 3, 1900. Its general range is given by Scudder as "United States from Rocky Mountains eastward."

104. ORCHELIMUM CAMPESTRE Blatchley.

Orchelimum campestre Bl., 10, XXV, 1893, 91; Id., 7, 1893, 133; Lugg., 84, 1898, 236; Scudd., 188, 1900, 73; McNeill, 90, XXXII, 1900, 78, 81.

A species of less than medium size, with wing covers narrow and of almost equal width throughout; the posterior femora unarmed beneath, and the ovipositor short, narrow, moderately upcurved, and tapering to a delicate point.

Cone of the vertex prominent, narrow, rounded at the apex; the sides of the frontal, deflexed portion rapidly converging to form a very acute wedge. Wing-covers long, slender, not narrowed in the middle as in *O. vulgare*, tapering slightly on the apical third to a rounded end; their length a little shorter than the wings in both sexes. Posterior femora with the basal half quite stout, the length less than that of the tegmina. Cerci of male slender, cylindrical, somewhat pointed, the apical half curved slightly outward, the basal tooth short and weak.

Color: Tegmina and wings almost uniform transparent olivaceous brown. The usual dark reddish brown band upon the occiput and disk of pronotum is margined on the latter with two very narrow and darker brown stripes, which extend back to the middle of the posterior lobe of the pronotum. Face, and usually the hind femora, a dirty olive brown; the latter, when dry, with a blackish longitudinal band on the exterior face. In the female the only green on the body is on the lower part of the sides of the pronotum and on the anterior femora. The males usually have the outer face of the posterior femora green, but otherwise are colored like the females. Ovipositor light reddish brown.

Measurements: Length of body, male, 17.5 mm., female, 19 mm.; of pronotum, male, 4.5 mm., female, 5 mm.; of tegmina, male, 20.5 mm., female, 24.5 mm.; of antennæ, male, 46 mm.; of posterior femora, male, 17 mm., female, 17.5 mm.; of ovipositor, 7 mm.

This modestly colored grasshopper is very common in the northern half of the State, where it abides in the tall grasses of the low prairie meadows. It has not, as yet, been taken south of Marion and Vigo counties. It is a smaller and more slender bodied insect than the common *O. vulgare* Harris, and has a shorter and narrower pronotum and a much smaller ovipositor than that species.

105. *ORCHELIMUM NIGRIPES* Scudder. The Black-legged Grasshopper.
Orchelimum nigripes Scudd., 151, XVII, 1875, 459; Id., 153, IV, 1875,
62; Id., 164, 1879, 12; Id., 168, XXIII, 1892, 73; Id., 188,
1900, 74; McNeill, 88, VI, 1891, 25; Id., 90, XXXII, 1900,
79, 83; Bl., 7, 1893, 135; Lugg., 84, 1898, 236.
Xiphidium nigripes Redtenb., 110, 1891, 188.

Somewhat smaller than *O. vulgare*; the body moderately robust. Pronotum short, the posterior lobe, especially in the male, rather strongly upturned. Tegmina equaling the wings in male, a little shorter in the female, surpassing slightly the hind femora. The shrilling organ of the male is unusually large and prominent with strong crossveins, and behind it the tegmina taper rapidly on both margins, their shape and the size of the tympanum causing the male to appear somewhat peculiar and much more robust than it really is. Hind femora armed on apical half of lower outer carina with one to four small spines. Cerci of male slender, tapering, the apex a little obtuse; the sub-basal tooth long, slender and a little curved. Ovipositor rather long, broadest in the middle, tapering to a delicate point. The males vary much in size.

General color green or reddish brown, the former prevailing in the male, the latter in the female. Occiput and disk of pronotum with the usual brown markings. Front and sides of head, and four front femora, reddish yellow. All the tibiae and tarsi, together with the apical third of hind femora, black or dark brown at least on the upper side; in one specimen at hand the whole body, except the wing covers and femora, black.

Measurements: Male—Length of body, 18 mm.; of antennae, 66 mm.; of pronotum, 5 mm.; of tegmina, 21 mm.; of hind femora, 16 mm. Female—Length of body, 19 mm.; of tegmina, 22 mm.; of hind femora, 17 mm.; of ovipositor, 9 mm.

The "black-legged grasshopper" is a lowland species, which has been taken in numbers in Vigo, Putnam, Posey, Starke, Fulton, Lake and Wells counties, and probably occurs in suitable localities throughout the State. It reaches maturity about July 20th, and is usually abundant about the margins of the larger ponds and lakes, where it frequents the tall grasses and especially the stems and leaves of the different species of *Polygonum*, or smartweed, growing in the shallow water. Examples of the parasitic hairworm (*Gordius* sp?) have been taken from the abdomens of a number of specimens.

Nigripes was described from Texas and was first recorded east of Illinois in my former paper. It has been taken by myself at Celina, Ohio, though Scudder gives its range as "Rocky Mountains to the

Mississippi River." Its song is much more faint than that of *vulgare*, the *z-e-e-e-e* being much less prolonged.

106. *ORCHELIMUM INDIANENSE* Blatchley.

Orchelimum indianense BL., 10, XXV, 1893, 90; Id., 7, 1893, 137; Scudd., 188, 1900, 73; McNeill, 90, XXXII, 1900, 79, 82.

A slender bodied insect, with a dark median streak down the face, and having the posterior femora unarmed beneath. The cone of the vertex is short, rather narrow, with a rounded apex. The tegmina, narrow, tapering, a little shorter than the wings, and of a delicate, almost gauze-like texture. Posterior femora slender, shorter than the closed tegmina. Anal cerci of male of medium size, longer than

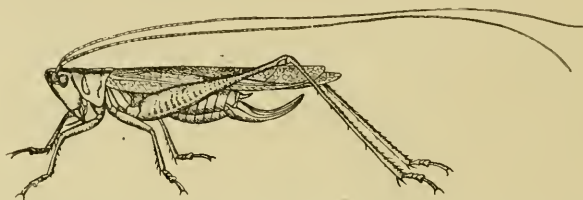


Fig. 97. *Orchelimum indianense* Bl. Female. One and one-half times natural size. (Original.)

the sub-genital plate, tapering to a dull point; the basal tooth short, with a broad base and a very sharp point. The ovipositor of female of less than average width and length, the apical half with a gentle upward curve.

Color: Tegmina and wings a transparent whitish tinged with green on the front or lower longitudinal nerves; the cross-nervules of the latter darker. Sides of pronotum and abdomen, and all the femora, light green; the tibiae and tarsi of a brownish hue. Face yellowish white, with a dark reddish brown stripe the width of the labrum, starting with the mouth and passing upward to the vertex, where it narrows to the width of that organ; then, broadening on the occiput, it passes back to the front border of the pronotum, where it divides into two narrow streaks, which enclose a whitish area and extend a little beyond the posterior transverse suture, where they taper to an end. Sub-genital plate of male yellow. Basal third of ovipositor dark brown, the remainder light reddish brown.

Measurements: Length of body, male, 17 mm., female, 17.5 mm.; of pronotum, male and female, 4 mm.; of tegmina, male, 21 mm., female, 19 mm.; of hind femora, male, 14 mm., female, 15.5 mm.; of ovipositor, 7.5 mm.

This graceful and prettily marked species is quite common among the rank grasses and sedges growing about the margins of tamarack swamps and lakes in Fulton, Marshall, Starke, Lake, Kosciusko and Steuben counties, where it reaches maturity about July 20th. It is probably a species of northern range which does not occur in southern Indiana. It is the smallest and most slender of the eight species of the genus so far known to occur in the State, and its markings are very distinct from those of any of the others.

107. *ORCHELIMUM DELICATUM* Bruner.

Orchelimum gracile Brun., 25, XXIII, 1891, 70.

Orchelimum delicatum Brun., 27, III, 1892, 264; Scudd., 188, 1900, 73; McNeill, 90, XXXII, 1900, 77, 80.

"A slenderer and somewhat smaller insect than *O. vulgare*, from which it differs in the form of its pronotum and of the ovipositor. The tubercle of the vertex is short, broad, and has the apex rounded. The tegmina and wings are of moderate length, very delicate in texture, and in the male furnished with an inconspicuous musical apparatus. Legs slender, the posterior femora not quite reaching the tips of the closed tegmina. Terminal segment of the male abdomen quite broad; the anal cerci stout and acuminate, with the internal tooth minute; sub-genital plate broad and long, reaching beyond the tips of the cerci. The ovipositor unusually long, broad, nearly straight and fine pointed.

"In color it is a pale transparent green with a broad reddish brown band upon the head and pronotum, continuous from the tip of the vertex to the posterior transverse indentation of the pronotum, somewhat paler in the middle; upon the latter, rather broadly bordered by yellowish white throughout. Face and mouth parts together with the genital armature of the male ochreous; ovipositor light reddish brown. Tarsi and sometimes also the tibiae a trifle infuscated."

"Length of body, male, 16 mm., female, 17.5 mm.; of antennæ, male and female, about 50 mm.; of pronotum, male, 3.8 mm., female, 4 mm.; of tegmina, male, 19 mm., female, 20 mm.; of hind femora, male, 14 mm., female, 15 mm.; of ovipositor, 11-12 mm."

This species was described from West Point and Lincoln, Nebraska, where Bruner found it common about the margins of ponds and along the edges of streams, also at electric lights. In Indiana it has been noted only in Marshall and Starke counties, where a half dozen specimens were secured in lowland meadows near large lakes on July 30th and August 20, 1902. It probably occurs throughout the lake region of the northern third of the State. It has not before been recorded east of Nebraska.

108. ORCHELIMUM GLADIATOR Bruner.

Orchelimum gladiator Brun., 25, XXIII, 1891, 71; Bl., 7, 1893, 138; Scudd., 188, 1900, 73; McNeill, 90, XXXII, 1900, 77, 81.

In its general structure this species resembles the more robust forms like *O. glaberrimum* and *O. nigripes*. It differs from these, however, in having shorter legs and antennæ, and in the shape of the ovipositor. The posterior femora are rather slender and unarmed beneath; the cone of the vertex is short and obtuse, with the extreme tip shallowly sulcate; the inner wings are the same length as the tegmina in the male, a little longer in the female, where they do not quite reach the tip of the ovipositor. The latter organ is broad, nearly straight and of more than ordinary length. Cerci of male stout, the basal tooth long, tapering gradually to a sharp point, its apical third a little curved.

Color: Pale transparent grass-green throughout, save the usual markings upon the occiput and disk of pronotum, which are dark brown; on the latter composed of two well defined, narrow, slightly diverging lines. Antennæ rufous, feet and extreme tip of the ovipositor tinged with rufous.

Measurements: Length of body, male, 17 mm., female, 18-20 mm.; of antennæ, male, 43 mm., female, 35 mm.; of pronotum, male, 5 mm., female, 4.75 mm.; of tegmina, male and female, 19 mm.; of hind femora, male, 14 mm., female, 15.5 mm.; of ovipositor, 10 mm.

This species has been found to be quite common in some of the northern counties, having been taken in low, damp meadows and marshes in Fulton, Starke, Marshall, Kosciusko and Steuben. It probably inhabits low damp prairies and meadows throughout the northern half of the State. It evidently begins to reach maturity about July 25th, perhaps a week sooner. A pair in coitu were secured in Marshall County on July 29th. It was described from Nebraska and has been recorded only from that State and Indiana.

109. ORCHELIMUM VOLANTUM McNeill.

Orchelimum volantum McNeill, 88, VI, 1891, 26; Id., 90, XXXII, 1900, 80, 83; Scudd., 188, 1900, 74.

Orchelimum bruneri Bl., 10, XXV, 1893, 92; Id., 7, 1893, 139; Scudd., 188, 1900, 73; McNeill, 90, XXXII, 1900, 80, 83.

A species of medium size and rather slender body with the posterior femora armed beneath, and the ovipositor very broad, nearly straight and of more than average length.

Cone of the vertex narrow, moderately elevated, rounded at apex. Tegmina long and narrow, a little shorter than the wings; strongly

reticulate in the female. Posterior femora rather stout, the apex, when appressed, just reaching the tip of ovipositor; armed beneath on the apical half with three or four small spines. Cerci of male stout, tapering to a point, with the internal tooth, rather broad and flat at base. Ovipositor very similar to that of *O. gladiator* Bruner, being very long and stout, nearly straight above, and with the under side of apical third sloping rapidly to the acute apex.

Color: With the exception of the ovipositor, which is a light reddish brown, and the usual stripe on occiput and disk of pronotum, the whole body is a pale, transparent brownish green, the green showing plainly only on the lower half of the side of the pronotum and on the meso- and meta-pleura.

Measurements: Length of body, male, 18 mm., female, 20.5 mm.; of tegmina, male, 21 mm., female, 25-28 mm.; of pronotum, male and female, 4.75 mm.; of hind femora, male, 16 mm., female; 19 mm.; of ovipositor, 10.5 mm.

As shown by the synonymy, this is the *O. bruneri* of my former paper, a comparison of type specimens of *volantum*, kindly loaned me by Professor McNeill, having proved the two to be identical. The Indiana specimens, however, do not show the character to which McNeill calls especial attention, namely, "the distinct angle formed by the anal area with the lateral field in the female tegmina."

In Indiana *volantum* has been taken in Vigo, Fulton, Marshall and Starke counties. It is found most abundantly during August and September on the leaves and stems of a tall, broad-leaved knot-weed, *Polygonum amphibium* L., which grows luxuriantly in the shallow waters about the margins of the larger ponds and lakes. Several other "green grasshoppers," notably among which are *Xiphidium attenuatum* Scudd. and *Orchelimum nigripes* Scudd., frequent this plant in large numbers. Keeping company with them an occasional specimen of *O. bruneri* is seen, but, being an active leaper, it often escapes amidst the dense foliage of the knot-weed before its capture can be effected.

Its less robust body, longer armed posterior femora and long tegmina will readily distinguish this species from *O. gladiator*, the only other one which, to my knowledge, has an ovipositor shaped like that of *volantum*.

Outside of Indiana, *volantum* has been taken only near Cleveland, Henry County, Illinois, where McNeill found it in small numbers on the semi-aquatic plant, *Sagittaria variabilis* Engelm, one of the arrow-heads. "Their song," says McNeill, "has a new note in it. It may be represented as follows: *zip-zip kr-ze-e-e, kr-ze-e-e*, the last part

of the song not lasting more than half to three-quarters of a second and is always preceded by the sound which I represent imperfectly by *kr*."

Sub-family DECTICINÆ.

All known North American representatives of this sub-family are apterous or sub-apterous, their tegmina never extending over more than two abdominal segments. The antennæ are inserted between the eyes, nearer the summit of the occiput than the upper margin of the labrum. Slit-like foramina (hearing organs) are present near the base of the fore tibiæ, and these tibiæ bear an apical spine on their outer upper side. The tarsi are all more or less depressed; and their first two joints are sulcate lengthwise on the sides; while the first joint of those of the hind legs bears a free plantula beneath its base.

The sub-family is represented in the Western States by numerous genera and a large number of species, but east of the Mississippi River but two genera and four species belonging to it have as yet been found. In Indiana but one of these genera, *Atlanticus* Seudder, represented by two species, is known to occur. However, members of the other eastern genus, *Orchesticus* Saussure, may in time be found within the State, since one of its species is known from Tennessee and another from Missouri. From other *Decticinae* the species of *Orchesticus* may be distinguished by the armed prosternum, the presence of four terminal spines on the lower side of hind femora, and an ovipositor which curves upward. This last character is the principal one separating them from *Atlanticus*, whose members have the ovipositor straight.

XLVIII. ATLANTICUS Seudder (1894).

The members of this genus are Locustidæ of large size, in which the pronotum extends back over the first joint of the abdomen, thus forming a buckler or shield for the back. Face broad, rounded, but slightly oblique. Eyes small, sub-globose. Vertex with a blunt decurved projection between the antennæ. Pronotum truncate in front, rounded behind, flattened above, bent abruptly downward on the sides. Prosternum armed with two slender, sub-acute spines. Tegmina of the females rudimentary, wholly covered by the pronotum; those of the males fairly well developed, extending in our most common species five or more mm. back of the pronotum. The shrilling organ, which is covered by the pronotum, is circular, and

rather large for the size of the tegmina. Wings very rudimentary or wanting. Hind femora long and rather slender, extending, in our species, beyond the abdomen in both sexes, notably so in the males. Ovipositor as long as the body, very stout at the base, straight.

The "Shield-back Grasshoppers," so called on account of the large protective pronotum, are often quite numerous from April 1st to September 15th in dry upland woods and on sloping hillsides with a southern exposure, but are seldom, if ever, found in damp localities.

On the first warm days of early spring the young begin to emerge and in suitable places for a month or more are among the most common Orthopterans seen. They are much more active during early life than in the mature state when they crawl rather than leap. In captivity they feed as readily upon animal as upon vegetable food, and in the natural state probably feed upon the dead bodies of such small animals as they can find. The earliest hatched reach maturity in central Indiana about the first of June, and may then often be found resting on the leaves and stems of low shrubs and weeds, but seldom climb over two or three feet from the ground. The adults are far less numerous than the young, the vast majority of the latter probably falling a prey to the many ground-frequenting sparrows and other birds, as they do not hide by day as do the members of the genus *Ceuthophilus*. The two Indiana species may be separated by the following key:

KEY TO INDIANA SPECIES OF ATLANTICUS.

- a.* Pronotum more than half as long as hind femora, its front margin in the female much narrowed, but little more than half as wide as hind margin; exposed portion of male tegmina almost as ample as the pronotum110 *pachymerus*, p. 393
- aa.* Pronotum not more than half as long as hind femora, its front margin in the female but little narrowed, about three-fourths the width of the hind margin; exposed portion of male tegmina less than one-third as ample as the pronotum.....111 *dorsalis*, p. 394

110. ATLANTICUS PACHYMERUS (Burmeister).

Decticus pachymerus Burm., 40, II, 1838, 712.

Thyreionotus pachymerus Scudd., 141, VII, 1862, 453; Coms., 41, I, 1888, 118, Fig. 106; Davis, 43, XXV, 1893, 108 (song of); Bl., 7, 1893, 150.

Atlanticus pachymerus Scudd., 170, XXVI, 1894, 179; Id., 188, 1900, 76; Lugg., 84, 1898, 245, Fig. 160.

Color: Male—Grayish or fuscous brown; the sides of pronotum and tegmina black, the former often shining, especially in the young; a narrow, curved yellowish line above the posterior lateral angle of

pronotum; the exposed dorsal field of tegmina light brown; the femora with numerous minute pale spots. Female—Usually grayish or reddish brown throughout, except the yellow line on side of pronotum, which is bordered above with a dash of black.

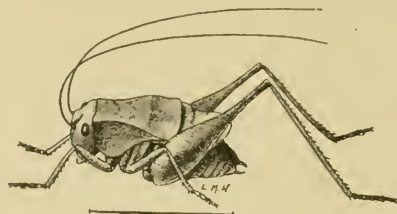


Fig. 98. *Atlanticus pachymerus* (Burm.). Male. (After Lugger.)

The lateral carinae of the pronotum are sharper in this species than in the next; the pronotum itself is proportionally a little longer, and appears more so than it really is on account of the broadly rounded posterior lobe. The hind femora, as well as the ovipositor, are a little shorter than in *dorsalis*, and the apex of the ovipositor is more bluntly rounded from above.

Measurements: Male—Length of body, 19 mm.; of pronotum, 9.5 mm.; of hind femora, 16.5 mm. Female—Length of body, 21 mm.; of pronotum, 9.5 mm.; of hind femora, 18 mm.; of ovipositor, 18 mm.

Pachymerus is, in Indiana, by far the more common of the two species. It has been taken in Lake, Marshall, Marion, Putnam, Vigo and Crawford counties, and doubtless occurs throughout the State, frequenting the localities mentioned above under the generic description. The earliest date on which a mature specimen has been noted was June 6th, in Vigo County.

In a pleasing account of the notes and habits of the species, Mr. W. T. Davis, *loc. cit.*, has written as follows: "Its song much resembles that of *Orchelimum vulgare*, with the preliminary *zip, zip*, omitted. It is a continuous *z-e-e-e*, with an occasional short *ih*, caused by the insect getting its wing covers ready for action after a period of silence. * * * Starting with raspberries, one kept in captivity had the rest of the fruits in their season, including watermelon, of which he showed a marked appreciation. If I offered him a raspberry and then gradually drew it away, he would follow in the direction of the departing fruit, and would finally eat it from my hand."

111. *ATLANTICUS DORSALIS* (Burmeister).

Decticus dorsalis Burm., 40, II, 1838, 713.

Thyreomatus dorsalis Scudd., 141, VII, 1862, 454; Id., 148, 1874, 370;

Comst., 122, I, 1888, 118; Bl., 7, 1893, 151.

Atlanticus dorsalis Scudd., 170, XXVI., 1894, 179; Id., 188, 1900, 75.

Color: Male—Usually a dark sooty brown flecked everywhere with grayish; the apical third of hind femora lighter; the yellow line on lower border of pronotum indistinct or wanting. Female—Dull, yellowish brown; the posterior lobe of pronotum, dorsum of abdomen and ovipositor dark brown. A blackish spot on the face below each eye; the sides of the pronotum with obsolete fuscous markings.

The chief structural distinctions between this insect and *pachymerus* are given above in the key and under the latter species. It may be added that the hind lobe of the pronotum in *dorsalis* is quite short and has its posterior margin nearly truncate; whereas in *pachymerus* it is much longer with the hind margin broadly rounded.

Measurements: Male—Length of body, 19 mm.; of pronotum, 9 mm.; of hind femora, 19 mm. Female—Length of body, 24 mm.; of pronotum, 9.5 mm.; of hind femora, 20.5 mm.; of ovipositor, 23 mm.

Dorsalis has been taken in the State in Putnam, Vigo, Knox and Crawford counties. In the two last named counties it is more common than the other species. Its general range is more southern and it will probably be found to inhabit only the southern half of Indiana.

Sub-family GRYLLACRINÆ.

This sub-family is represented in the State by the single genus,

XLIX. CAMPTONOTUS Uhler (1864).

Form similar to *Ceuthophilus* Scudd. Head large, oval, much broader than the prothorax and not deeply sunken into it. Eyes ovate, vertical, situated on the sides but little behind the basal joint of the antennæ, and exceeding it a little in length. Maxillary palpi long, the last joint as long as the preceding one, a very little inflated at the tip. Antennæ at least five times the length of the body without the ovipositor. Pronotum trapezoidal, the sides not carried downwards as far as the lower line of the eyes, the lateral margins somewhat broadly recurved; meso- and meta-notum very small, confined to the dorsum and not prolonged downward upon their sides. Ovipositor ensiform, curved upwards, its valves compressed, acute. Legs very short, moderately stout; the anterior and middle tibiæ slightly incurved near the base, having a row of four long spines each side beneath; posterior femora armed beneath with a few short teeth. Tarsi stout, four-jointed, with split cushions beneath, the first joint equal in length to the two following ones conjoined.

A single species is known from the eastern United States.

112. CAMPTONOTUS CAROLINENSIS (Gerstaecker).

Gryllacris carolinensis Gers., 59, XXVI, 1860, 276.*Neortus carolinensis* Brunn., 39, 1888, 381.*Camptonotus carolinensis* Scudd., 188, 1900, 79.*Camptonotus scudderi* Uhler, 212, II, 1864, 549; *Glov.*, 62, 1872, Plate VIII, Fig. 15; Riley, 122, II, 1884, 186.

A medium sized wingless Locustid, reddish brown above, yellowish white beneath. Face and all the tibiae and tarsi yellowish, the femora, especially the two hind pair, mottled with dark brown, and a transverse bar of the same color on the three posterior dorsal segments of abdomen.

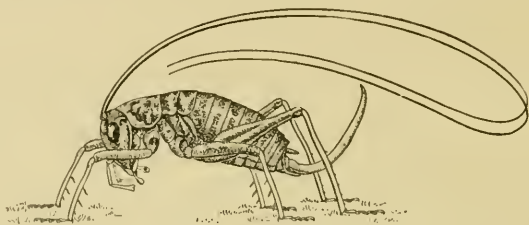


Fig. 99. *Camptonotus carolinensis* (Gerstaecker). Female. Twice natural size. (Original.)

Measurements: Female—Length of body, 12 mm.; of posterior femora, 7.5 mm.; of ovipositor, 8 mm.

A single female of this curious Locustid was taken October 11, 1902, near Millersville, Marion County, by Philip Baker, of Indianapolis, who kindly presented it to me. I had seen one in Vigo County ten years before but had failed to effect its capture. It has been heretofore taken only in Maryland, Delaware and the Carolinas. Near Baltimore, according to Uhler, it appears in the larval state as early as the first of August and reaches maturity the latter part of September. It is there found upon oak trees, where it is said to spend the day time curled up in the leaves. It will probably be found to occur in small numbers on oaks throughout the southern half of Indiana.

Since the above was in type, two pairs of the half grown young of *C. carolinensis* have been taken, one pair from near Mitchell, Lawrence County, on July 15th; the other from near Montezuma, Parke County, on July 22d. Both pairs were beaten from oak bushes while collecting beetles.

Sub-family STENOPELMATINÆ.

The Indiana members of this sub-family comprise those insects which are commonly called "stone" or "camel crickets," and, so far as known, belong to the single genus *Ceuthophilus*, which is characterized below.

L. CEUTHOPHILUS Scudder (1862).

Wingless Locustidæ of medium or large size with a thick body and arched back. Head large and oval, bent downward and backward between the front legs. Antennæ long, slender, cylindrical and tapering to a fine point. Eyes sub-pyriform, the narrow end downward, placed a little above and close to the basal joint of the antennæ. Maxillary palpi long and slender; the apical joint longest, somewhat curved, split on the under side three-fourths of its length, which is nearly equal to that of the two preceding taken together. Pronotum short, not extending over the meso and meta-notum. Prosternum unarmed. Hind femora thick and heavy, turned inward at the base, channeled beneath, with the margins of the channel either serrate or spined in the males, seldom armed in the females. Ovipositor well developed, nearly straight, a little upturned at the tip, the inner valves usually strongly serrate on the under side of the apical fourth. Cerci of males long, slender, usually very hairy.

These insects are seldom seen except by the professional collector. They are nocturnal in their habits, and during the day hide beneath stones along the margins of small woodland streams, or beneath logs and chunks in damp woods, in which places seldom less than two, nor more than three or four, are found associated together. Being wingless they make no noise, and, like most other silent creatures, are supposed to be deaf, as no trace of an eardrum is visible.

That they are well-nigh omnivorous in their choice of food, I have determined by keeping them in confinement, when they fed upon meat as well as upon pieces of fruit and vegetables, seemingly preferring the latter. The majority of the species evidently reach maturity and deposit their eggs in the late summer or early autumn, as the full grown insects are more common then, but have been taken as late as December 1st. The eggs, which are supposed to be laid in the earth, usually hatch in April, but some are hatched in autumn and the young live over winter, an anomaly among the Locustidæ, as I have taken them on a number of occasions throughout the winter. Several of the species inhabit caves and are usually of larger size, with longer antennæ and smaller compound eyes than those found above ground.

The adult males of these insects are quite readily separated by the size, number and relative position of the spines on the under side of the hind femora, as well as by the degree of curvature of the corresponding tibiæ. The females, having neither the spined posterior femora nor the curved tibiæ, are less readily distinguished by

the color and the relative measurements of the different organs. As the two sexes are colored alike and are usually found in close proximity there will be little difficulty in placing the female after determining the male by the key given below, which mainly pertains to that sex alone.

Seven species have, up to the present, been taken by the writer in Indiana.

KEY TO INDIANA SPECIES OF CEUTHOPHILUS.

- a. Fore femora but little, if any, longer than the pronotum.
 - b. Hind tibiae of male arcuate or sinuate in basal half; the hind femora of male with about 13 small, unequal spines on the outer lower carina.....113 *maculatus*, p. 399
 - bb. Hind tibiae of male straight; hind femora of adult male with 8 to 11 rather large, unequal spines on the lower outer carina; a broad, dark brown or blackish stripe on either side of dorsal surface of body.....114 *latus*, p. 400
- aa. Fore femora one-third or more longer than the pronotum.
 - c. Hind femora distinctly shorter than the corresponding tibiae; cave inhabiting species115 *stygius*, p. 401
 - cc. Hind femora but little, if any, shorter than the corresponding tibiae; species living above ground.
 - d. Lower outer carina of hind femora of male conspicuously spined.
 - e. Inferior sulcus of hind femora of male quite deep and of uniform width; the outer carina with seven to nine spines of unequal length and not equidistant116 *blatchleyi*, p. 403
 - cc. Inferior sulcus of hind femora of male shallow and broad; wider at base than at distal end; the spines of the outer, lower carina sub-equal in size and equidistant117 *uhleri*, p. 404
 - dd. Lower outer carina of hind femora of male never conspicuously spined.
 - f. General color clear reddish brown, mottled with paler; hind femora of male more than twice as long as the fore femora; each of the lower carinae with about 25 crowded minute teeth.....118 *terrestris*, p. 406
 - ff. General color dull sooty brown with numerous paler spots; hind femora of male about twice as long as the fore femora, with seven to 15 small but distinct teeth on each of the carinae.....119 *brevis*, p. 406

113. *CEUTHOPHILUS MACULATUS* (Say). The Spotted Camel Cricket.

Raphidophora maculata (Say MS.), Harris, 71 1841, 126; Scudd., 140, VIII, 1861, 7, 11, 14.

Phalangopsis maculata Harris, 72, 1862, 155, Fig. 73.

Ceuthophilus maculatus Scudd., 141, VII, 1862, 434; Id., 171, XXX, 1894, 27, 68; Id., 188, 1900, 82; Glov., 62, 1872, Plate III, Fig. 5; Pack., 104, 1883, 565; Riley, 122, II, 1884, 184, Fig. 259; Brunn., 39, 1888, 307; Bl., 7, 1893, 142; Id., 16, 1899, 222, Fig. 53; Lugg., 84, 1898, 249, Fig. 163.

General color: Above, dark sooty brown, with often a median stripe of lighter brown on the thoracic segments; below a yellowish brown. The abdominal segments bear on their dorsal surface a number of small yellow dots, often confluent and sometimes in regular transverse rows. Antennæ and legs light reddish brown, the hind femora cross-barred with narrow darker brown bars arranged in parallel rows.

Anterior femora a little longer than pronotum, the inner carina with one or two rather long sub-apical spines. Hind femora about the length of the body; the lower sulcus narrow and of medium depth, its outer carina in the male with twelve to fifteen unequal, rather coarse spines; the inner carina with about the same number

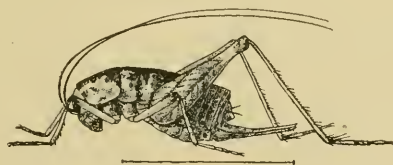


Fig. 100. *Ceuthophilus maculatus* (Say). Female. (Afer Lugger).

of smaller and sub-equal spines; the female with a number of small, inconspicuous spinules on each carina. Hind tibiæ a little longer than the femora, the basal third distinctly arcuate or bowed in the male. Cerci with the basal half stout, tapering beyond. Ovipositor two-thirds as long as the hind femora, gently tapering to the tip, which is slightly upturned, the teeth of the inner valve sharp.

Measurements: Male—Length of body, 14 mm.; of pronotum, 5 mm.; of front femora, 6 mm.; of hind femora, 15 mm.; of hind tibiæ, 17 mm. Female—Length of body, 16 mm.; of pronotum, 5 mm.; of front femora, 6 mm.; of hind femora, 16 mm.; of ovipositor, 10 mm.

This "spotted wingless grasshopper" has the widest range of any of the 56 species of *Ceuthophilus* listed by Scudder, having been recorded from nearly every State east of the Great Plains. In In-

diana it is, as far as my observation goes, much less common than some of the other species of the genus, having so far been taken only in Crawford and Putnam counties. In the former county a number of specimens were secured in June and July from beneath logs and chunks in dry upland woods. In Putnam County it was found on August 1st beneath a log in a damp ravine. It probably occurs sparingly in like situations throughout the State.

114. *CEUTHOPHILUS LATENS* Scudder. The Black-sided Camel Cricket.

Ceuthophilus latens Scudd., 141, VII, 1862, 437; Id., 171, XXX, 1894, 29, 64; Id., 188, 1900, 82; Bl. 7, 1893, 143.

General color: Light reddish brown; two broad bands of dark fuscous or blackish along the thorax and one or more of the basal segments of abdomen, extending half way down the sides and separated from one another by a median stripe of light reddish brown. Below the black stripes the sides are pale yellowish brown; while the greater part of the abdomen, as well as the outer face of the hind femora, is dotted with brownish yellow, the dots sometimes confluent, sometimes in apparently regular rows. The legs are light brown, the tips of the hind femora infuscated.

The fore femora a little stouter than the middle pair, nearly a third longer than the pronotum in the male; but little longer in the female, the inner carina with two or three spines. Middle femora with two to four spines on each carina beneath. Hind femora thick and stout, the inferior sulcus of average width and depth, the margins with several minute spines in the females; the outer carina of adult males with eight or nine spines, the four or five middle ones of which are quite strong and prominent, the inner carina with 11 to 14 small and sub-equal spines.

Hind tibiae straight, very little, if any, longer than the femora; the inner calcaria much longer than the outer, and as long as the first tarsal joint. Cerci slender, gently tapering throughout, longer than the greatest width of hind femora. Ovipositor nearly twice as long as fore femora, straight, the tip a little upturned and acute.

Measurements: Length of body, male, 22 mm., female, 24 mm.; of pronotum, male and female, 6.5 mm.; of front femora, male, 8.5 mm., female, 7 mm.; hind femora, male and female, 19 mm.; of hind tibiae, male, 21 mm., female, 20 mm.; of ovipositor, 11 mm.

Mr. Scudder has evidently described this species from immature specimens of both sexes. As a consequence, his measurements are much less than those given above. The spines on lower outer carinae of males are more numerous and more prominent in the

adults than in the two-thirds grown young, where they are sub-equal in size. The black markings at base of tibial spines, used by Scudder in his key, are seldom present in the adults and are therefore of no value as a distinguishing character. I have, in recent years, taken numerous specimens of the large form mentioned in my former paper, and described herewith, in company with the immature forms described by Scudder, and there is no doubt but that the two are the same.

C. latens has proven to be a rather common species in Indiana, having been taken in Vigo, Putnam, Crawford, Kosciusko and Steuben counties. It is most commonly found beneath small chunks or flat stones in rather dry sandy localities. Sometimes a half dozen will be found in company beneath the same shelter. It reaches maturity about July 20th, probably from specimens hatched in spring, though I have taken the young on two different occasions in February. The species is sometimes affected by the parasitic hairworm, *Gordius* sp.? According to Scudder, it ranges from "New York to Texas."

115. *CEUTHOPHILUS STYGIUS* (Scudder). The Cave Camel Cricket.

Raphidophora stygia Scudd., 140, VIII, 1861, 9.

Ceuthophilus stygius Scudd., 141, VII, 1862, 438; Id., 171, XXX, 1894, 24, 33; Id., 188, 1900, 84; Pack., 104, 1869, 565; Id., 106, IV, 1888, 70, 83; Riley, 122, II, 1884, 184; Brunn., 39, 1888, 309; Bl., 7, 1893, 148; Id., 14, 1897, 198; Id., 16, 1899, 175.

Ceuthophilus sloanii Pack., 105, V, 1873, 93; Id., 106, IV, 1888, 71, 83.

Pale, reddish brown, the hind border of each segment with a dark brown band, the pronotum with a similar band on the front margin, and an indistinct, dark median band connecting the two. Face pale with usually a black dash below each eye, and a shorter median one. Antennæ brownish yellow, paler toward the tip, of excessive length, averaging four times the length of body. Legs all very long and slender. Front femora, in the specimens at hand, double the length of the pronotum, with two to five spines on the lower front carina. Middle femora shorter than the anterior with both of the lower carinæ armed with three or four distinct spines. Hind femora rather slender, nearly as long as the body, the lower, outer carina prominent; the inferior sulcus narrow and of average depth; both margins armed with numerous small spines, those on the outer carina of male double the size of those on the inner. Hind tibiæ straight, longer than the corresponding femora. Hind tarsi two-fifths the length of the tibiæ. Cerci slender and tapering, nearly half as long as hind femora. Ovi-

positor straight, the apical two-thirds of nearly the same diameter, the tip scarcely upturned; the teeth of inner valve feebly crenate.

Measurements: Length of body, male, 30 mm., female, 26 mm.; of pronotum, male, 7.5 mm., female, 6.5 mm.; of front femora, male, 15 mm., female, 12.5 mm.; of hind femora, male, 26 mm., female, 24 mm.; hind tibiae, male, 27.5 mm., female, 25 mm.; of antennae, male, 103 mm., female, 96 mm.; of ovipositor, 16 mm.

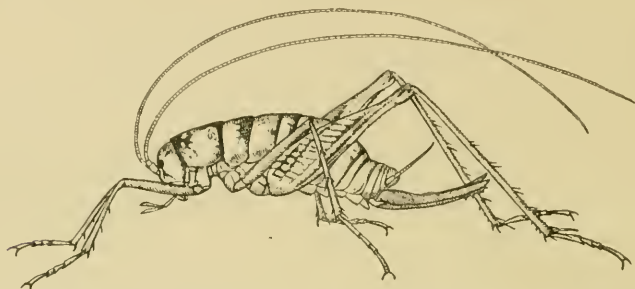


Fig. 101. *Ceuthophilus stygius* (Seudder). Female. One and one-fourth times natural size. The antennae are half as long again as shown in the cut. (Original.)

This "cave cricket" occurs abundantly in crevices in the walls and roof near the mouths of Wyandotte, Little Wyandotte, Sibert's Well Cave and Saltpetre Cave, Crawford County, and a few immature specimens, pronounced by Mr. S. H. Seudder to be the same species, have been taken in Porter's Cave, Owen County and Truett's and Strong's caves, Monroe County, 80 miles farther north. In the Crawford County caves no specimens were found further back than 250 feet from the mouth, except in Wyandotte, where a few have been taken on "Monument Mountain," one-half mile from the mouth. In the other caves they were found back beyond the reach of any rays of light.

The adults of this species are the largest "stone" or "cave crickets" occurring in the State and seem to be more or less gregarious. In one instance, in Sibert's Well Cave, more than 20 were found in a small cranny in the wall. They were grouped in a circle, in a space about six inches square, with their antennae pointing toward the center of the circle, and appeared to be holding a conference or cricket convention.

In regard to the life history of this insect, but little is known. I found a number of specimens of half grown young in Sibert's Cave on May 16, 1895. The adults were common in July, 1896; and in November, the young about one-third the size of mature specimens were frequent in Saltpetre Cave, but could not be found elsewhere.

The species may be represented in winter by the eggs as well as by the young, as is the case among some other members of the genus.

In Saltpetre Cave, where in July *stygius* was very plentiful, all were found within 100 feet of the entrance. They were never seen on the floor, unless they leaped there when disturbed, but were found resting on the sides of small projections and in small cavities of the walls or roof, with their antennæ spread out before them. If a lighted candle was held close to them they paid no attention to it, but were very sensitive to its heat and to touch. When disturbed they leap with agility, sometimes to a distance of six feet, but with a little care can usually be readily picked up with the fingers before they become frightened.

The immature specimens from caves in Monroe and Owen counties were darker than typical *stygius*, and were found on the floors of the caves—in one or two instances beneath loose rocks. From their habits I am somewhat inclined to doubt their being *stygius*, since it is quite difficult to name correctly the young of any species of *Ceuthophilus*.

116. *CEUTHOPHILUS BLATCHLEYI* Scudder.

Ceuthophilus blatchleyi Scudd., 171, XXX, 1894, 26, 57; Id., 188, 1900, 81; Lugg., 84, 1888, 249.

Ceuthophilus uhleri Bl., 7, 1893, 144. (Not *C. uhleri* Scudd.)

General color: Light reddish brown, the meso and meta-notum usually darker. The pronotum rather thickly and irregularly mottled with paler spots; the other segments with the pale spots for the most part in a transverse row near the hind margin. The legs yel-



Fig. 102. *Ceuthophilus blatchleyi* Scudd. Male. One and one-fourth times natural size. (Original.)

lowish brown, the hind femora with the apex a little dusky above and with numerous oblique transverse dusky bars on the outer face. In a few specimens the general color is much darker and the outer face of the hind femora is a fuscous brown almost black in hue.

The anterior femora are but little longer than the pronotum; the lower front margin armed with from one to four spines. Hind femora of the male of average width but rather slender and tapering; the inner surface of the upper portion of the apical half with numerous raised points; the lower outer carina prominent, with the inferior sulcus rather narrow and very deep, the sides meeting at an angle above. The spines of the outer carina are usually arranged in three sets, the basal set containing two to four equidistant graduated spines, the distal one largest; the middle set contains but a single strong spine equal in size to the one before it and separated from it as well as from the first one of the apical set, by a space almost twice as great as between the members of the basal set; the apical set of four small, sub-equal spines. The inner carina is armed with about 16 small sub-equal spines. The female has the inner carina also armed in like manner with still smaller spines. Hind tibiae of male straight, a little longer than the femora; distinctly longer in the female. Cerci gradually tapering from a rather stout base, about as long as the breadth of the hind femora. Ovipositor about two-thirds the length of hind femora.

Measurements: Length of body, male, 14 mm., of female, 16 mm.; of pronotum, male and female, 5 mm.; of fore femora, male, 6.5 mm., female, 6 mm.; of hind femora, male, 15 mm., of female, 13.5 mm.; of hind tibiae, male and female, 16 mm.; of ovipositor, 9 mm.

This species may be readily known from the next, its closest ally, by the more slender hind femora of the male, the narrower inferior sulcus of these femora, and by the different armature of their lower outer carina.

In central Indiana, *blatchleyi* is the most common species of *Ceuthophilus*. It is usually found from July to November in small colonies of three to six or more, beneath rails and logs in rather dry situations. It is especially fond of low, open second bottom woods, with a loamy or sandy soil. The young have been taken in similar places in December and February, but evidently the larger number of eggs do not hatch until spring. It has not, as yet, been taken in either the northern or southern third of the State, but probably occurs throughout as it has been recorded from New York, Minnesota and Iowa.

117. *CEUTHOPHILUS UHLERI* Scudder. Uhler's Camel Cricket.

Ceuthophilus uhleri Scudd., 141, VII, 1862, 435; Id., 171, XXX, 1894, 26, 56; Id., 188, 1900, 84; Glov., 62, 1872, Plate VIII, Fig. 8; Riley, 122, II, 1884, 184; Brunn., 39, 1888, 64, Fig. 33b.

Ceuthophilus latusulcus Bl., 7, 1893, 146.

General color: Light brownish or clay yellow, irregularly flecked with fuscous, especially on the pronotum and abdomen; the female somewhat darker. Legs light brown, more or less infuscated on the apical portions of the femora. The anterior femora more than a third longer than the pronotum in the male, shorter in the female, with two sub-equal spines near the apex of the lower front carina. The intermediate femora with three spines on each of the lower carinae. The hind femora shorter and not so broad as in the preceding, the outer lower carina much less prominent; the upper half of the exterior face very scabrous, with small projections. The inferior sulcus exceptionally broad and shallow, about twice the breadth and one-half the depth of that of *C. blatchleyi*; the sides not meeting in an angle as there, but the top of the sulcus flat. The outer carina with seven or eight sub-equal spines borne at equal distances apart on the apical half; the middle two slightly the larger but much less strong than the corresponding one of *C. blatchleyi*. The inner carina armed with 16 to 20 very small teeth. In the female the inferior sulcus is much less broad and the carinae bear only a few small teeth on their apical half. The hind tibiae of male with a very slight curve just below the base; a little longer than the corresponding femora in both sexes. Cerci rather stout, shorter than the femoral breadth. Ovipositor but little more than half as long as hind femora, the tip considerably upturned and finely acuminate.

Measurements: Length of body, male, 15 mm., female, 16 mm.; of pronotum, male and female, 5 mm.; of front femora, male, 7.5 mm., female, 6 mm.; of hind femora, male, 17.5 mm., female, 13.5 mm.; of hind tibiae, male, 18.5 mm., female, 15.5 mm.; ovipositor, 8 mm.

From *C. blatchleyi*, which it most resembles, this species may at once be known by the longer anterior femora, the much broader and shallower sulcus of the hind femora, as well as by the difference in size and arrangement of the teeth upon the latter. The adult male is larger, with shorter and broader hind limbs than those of *blatchleyi*, though the males of both these species are much more robust when mature than those of *C. maculatus* and *C. terrestris* which have come under my notice.

In Indiana, *uhleri* is much less common than the preceding species, having been taken in small numbers only in Vigo and Marion counties, where it occurs mature in August beneath logs and rubbish in dry sandy localities. It has been recorded from the Middle States, Maryland and Georgia.

118. *CEUTHOPHILUS TERRESTRIS* Scudder.

Ceuthophilus terrestris Scudd., 171, 1894, 26, 46; Id., 188, 1900, 84.

Raphidophora lapidicola Scudd., 140, VIII, 1861, 7.

Ceuthophilus lapidicolus Scudd., 141, VII, 1862, 435; *Glov.*, 62, 1872, Plate VII, Figs. 4, 5; Riley, 122, II, 1884, 184; *Bl.*, 7, 1893, 147.

Clear reddish brown, mottled with small pale spots, especially on the abdomen, where the spots have a tendency to arrange themselves in longitudinal rows. Often, but not always, a median light stripe on the dorsal portion of the pronotum, bordered by darker fuscous blotches. The legs paler, the exterior face of the hind femora with the usual darker transverse bars, but not so prominent as in *C. maculatus*.

Anterior femora a little longer than pronotum, unarmed beneath. Intermediate femora also unarmed or with a single apical spine on front margin. Hind femora about equaling the body, rather stout, the inferior sulcus of average width, rather deep; both carinae of male bearing numerous small serrations, like the fine teeth of a saw, about 25 in number and crowded on the apical two-thirds of the segment; those of the female unarmed or with a few very fine teeth on the apical third. Hind tibiae straight, a little shorter than the femora. Ovipositor less than three-fifths the length of hind femora, the tip upturned a little and pointed.

Measurements: Male—Length of body, 13 mm.; of pronotum, 5 mm.; of front femora, 6 mm.; of hind femora, 14 mm.; of hind tibiae, 15 mm. Female—Length of body, 16 mm.; of fore femora, 6.5 mm.; of hind femora, 15 mm.; of ovipositor, 8 mm.

C. terrestris is in Indiana less common than any other species of the genus, having been taken only in Putnam and Vigo counties. The most of those secured were in April and the specimens were probably only about half grown. Its general range includes the northern United States and Canada, east of the Mississippi River.

119. *CEUTHOPHILUS BREVIPES* Scudder.

Ceuthophilus brevipes Scudd., 141, VII, 1862, 434; Id., 171, XXX, 1894, 26, 49; Id., 188, 1900, 81; *Bl.*, 7, 1893, 148.

Dull sooty brown, a little darker on the dorsum of the thorax where there is usually a narrow median line of clay yellow. Very profusely spotted with dull yellow spots, especially on the posterior margins of the abdominal segments. Near the apex of the hind femora, these spots nearly form an annulation of yellow, more noticeable on account of the more or less dark band beyond.

Body robust; front femora a third or more longer than the pronotum, with a single spine on lower front carina. Hind femora short and stout; the inferior sulcus of average width and depth; both carinae of male armed on apical half with seven to 15 small saw-like teeth; those of female with similar but smaller serrulations. Hind tibiae straight, distinctly longer than the femora, the inner calcaria considerably longer than the outer, but shorter than the first tarsal joint. Cerci tapering from a rather stout base, a little longer than the femoral breadth. Ovipositor rather slender, two-thirds the length of hind femora, its apical third very slightly arcuate, the tip but little upturned; teeth of the inner valve small and distant from one another.

Measurements: Male—Length of body, 16.5 mm.; of pronotum, 5.5 mm.; of front femora, 8.5 mm.; of hind femora, 16 mm.; of hind tibiae, 18.5 mm. Female—Length of body, 16 mm.; of pronotum, 5.5 mm.; of fore femora, 6.5 mm.; of hind femora, 15.5 mm.; of hind tibiae, 17 mm.; of ovipositor, 10.5 mm.

This is another species where the measurements of Indiana specimens greatly exceed those given by Mr Seudder in his Monograph. It is not common in the State, being represented in my collection only by specimens from Vigo and Orange counties; those from the former county, taken in September and October, being full grown, while those from Orange County, taken in May, are but little more than half as large.

Aside from these Indiana localities, the species has been recorded only from Maine and New Brunswick.

Family GRYLLIDÆ.

The third family of Orthoptera belonging to the sub-order *Saltatoria* comprises the *Gryllidæ* or crickets. From the other Orthopterous insects they may be distinguished by having the wing covers flat above and bent abruptly downward at the sides; the tarsi or feet, three jointed, without pads between the claws; the fore coxæ longer than broad. Ocelli or simple eyes are present in the majority of species; while the antennæ, like those of the *Locustidæ*, are long, slender and many jointed. The hearing organ, when present, is, as there, situated on the base of the fore tibiae.

The tympanum or calling organ of the male is also, as in the *Locustidæ*, located near the base of the dorsal surface of the tegmina, but is wider and broader than in the preceding family, extending across both anal and median areas of the tegmina. The chirps or

love calls of the different species of crickets make up the greater part of that ceaseless thrill which fills the air, usually at night, from mid-August until after frost. These sounds are made only by the males, and are not vocal, as most persons suppose; but are produced by the tympanum, the insect rubbing the veins in the middle of one wing cover over those of the other. It is often difficult to locate one of these chirpers by its song. The distance and even the direction are often most deceiving; the crickets being exceedingly shy, much more so than katydids and grasshoppers. Those which live in the ground generally chirp near the entrance to their burrows, and retreat thereto at every approaching footstep. Those which live upon trees or shrubs resemble closely the hues of bark or foliage, and are therefore difficult to find even when close at hand; while the majority, dwelling as they do, among grasses and beneath logs and chips, find also a safe protection in their color, which is usually closely like that of the objects beneath which they rest while sounding their cymbals.

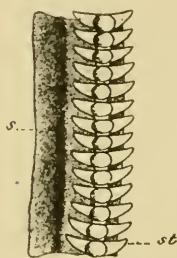


Fig. 103. Stridulating ridges in a house-cricket; *s*, stridulating ridge; *st*, stridulating teeth. (After Landois.)

The inner wings of the crickets are, for the most part, short, weak, and comparatively useless as flying organs, though sometimes they are nearly twice as long as the outer pair. Like their nearest relatives, the grasshoppers and katydids, these insects, therefore, travel mostly by leaps and, in the course of time, their hind femora have thus become greatly enlarged.

The ovipositor of the female, when exposed, is usually a long, cylindrical spear-shaped organ, consisting apparently of two pieces. Each of these halves, however, when closely examined, is seen to be made up of two pieces so united as to form a groove on the inner side, so that when the two halves are fitted together, a tube is produced, down which the eggs pass to the repository in the earth or twig, fitted to receive them.

The eggs of most crickets are laid singly in the ground. A few of the burrowing species deposit them in irregular masses in underground cavities. The tree crickets place them uniformly in a single row in the pith of twigs. Most species are represented in winter by the eggs alone. A few, however, pass the cold season as nymphs, or as adults. The mole crickets are said to exist for several years.

Among the families of Orthoptera the *Gryllidæ* and *Locustidæ* take a rank superior to all others. The high specialization of the ovipositor of the female and the perfection of structure of the stridulating

organ of the male place these two families above all others in the scale of Orthopteran life. That the two are very closely related can be readily seen by any one who will carefully compare them, organ with organ. The *Gryllidæ* are placed first, however, by most entomologists, as the great variety of form of almost any given organ among them, when compared with its relative uniformity of structure among the *Locustidæ*, seems to indicate the higher rank of the former.

About 67 species of *Gryllidæ* are known from the United States. These are divided among six sub-families and 17 genera. All of the sub-families and 12 of the genera are represented among the species known to occur in Indiana. The sub-families may be distinguished by the following table:

A SYNOPSIS OF THE SUB-FAMILIES OF GRYLLIDÆ KNOWN TO OCCUR IN INDIANA.

- a. Tarsi compressed, the second joint minute, compressed.
 - b. Fore tibiæ enlarged, fitted for digging; female without exposed ovipositor (Mole and sand crickets)....GRYLLOTALPINÆ, p. 410
 - bb. Fore tibiæ not enlarged; female with well developed external ovipositor.
 - c. Hind tibiæ bearing two rows of minute teeth and a few movable spines. Body very small, sub-spherical; hind femora short, much swollen. (Our species living in ants' nests) MYRMECOPHILINÆ, p. 415
 - cc. Hind tibiæ bearing two rows of spines; body of larger size, sub-elongate, with longer and more slender hind femora.
 - d. Hind tibiæ rather stout, armed with stout spines without teeth between them. (Ground and field crickets)GRYLLINÆ, p. 418
 - dd. Hind tibiæ slender, armed with delicate spines (except in the genus *Xabca*), with minute teeth between them. (White tree crickets)..... ÆCANTHINÆ, p. 443
- aa. Second tarsal joint distinct, depressed, cordiform.
 - c. Hind tibiæ bearing two rows of spines without teeth between them. Ovipositor in our species compressed and curved upward. (Small black or brown tree crickets)..... TRIGONIDINÆ, p. 454
 - ee. Hind tibiæ bearing two rows of spines with small teeth between them. Ovipositor in our species cylindrical, but little upcurved. (Larger brown tree crickets)..... ENEOPTERINÆ, p. 457

Sub-family GRYLLOTALPINÆ.

This sub-family includes the burrowers among our crickets. The species have the fore limbs so modified that they can make their way readily beneath the surface. The antennæ are much shorter and less tapering than in the species living above ground. The ovipositor of the female is not visible externally.

Three genera are represented in Indiana which may be separated by the following key:

KEY TO GENERA OF INDIANA GRYLLOTALPINÆ.

- a.* Species of large size; fore tibiæ broadly expanded, the claws prominent; two large ocelli present; hind femora slender; tarsi three-jointedLI. GRYLLOTALPA, p. 410
- aa.* Species of small size; fore tibiæ not broadly expanded but bearing three or four spines at the apex; three small ocelli present; hind femora much swollen; tarsi one-jointed or wanting.
 - b.* Species more than 5.5 mm. in length; pronotum with a weak transverse sulcus; hind tibiæ with four pairs of long slender plates used in swimming; hind tarsi one-jointed.....
LII. TRIDACTYLUS, p. 413
 - bb.* Species less than 5.5 mm. in length; pronotum with no transverse sulcus; hind tibiæ with a single pair of short plates used in swimming; hind tarsi wholly wanting.....
LIII. ELLIPES, p. 415

LI. GRYLLOTALPA Linnæus (1767).

Among all the Gryllidæ found in Indiana the mole crickets rank first in size and singularity of structure. When full grown they measure from an inch and a fourth to an inch and a half in length; are light brown in color and have the body covered with very short hairs, giving it a soft, velvety appearance. The females have no visible ovipositor, and, externally, may be separated from the males only by the difference in the veining of the uppermost of the wing covers, due to the presence of a tympanum in the latter sex. By their habit of burrowing beneath the soil in search of such food as the tender roots of plants, earthworms and the larvæ of various insects, the anterior tibiæ of these crickets have, in the course of ages, become so modified in structure as to closely resemble the front feet of the common mole, whence the generic name, *Gryllotalpa*, from "*gryllus*," a cricket, and "*talpa*," a mole. The dactyls or claws of these tibiæ are four in number, the upper two, the larger, being movable; the others immovable. The compound eyes have, on account of the underground life, become much aborted, being not more than one-fourth the size of those of the common field crickets, of

the genus *Gryllus*. As the mole crickets crawl rather than leap, the hind femora are but little enlarged, and are always shorter than the pronotum. The hind tarsi are short, seldom exceeding half the width of the pronotum. But one species occurs in Indiana.

120. *GRYLLOTALPA BOREALIS* Burmeister. The Northern Mole Cricket.

Gryllotalpa borealis Burm., 40, II, 1838, 740; Scudd., 145, I, 1869, 25, Plate I, Figs. 9, 34, 35; Id., 148, 1874, 363, Plate A, Fig. 7; Id., 154, X, 1876, 97 (note of to music); Id., 168, XXIII, 1893, 63 (note of to music); Id., 188, 1900, 86; Glov., 62, 1872, Plate VII, Fig. 13; Id., 63, 1874, 143, Fig. 17; Pack., 104, 1883, 563; Comst., 41, I, 1888, 120, Fig. 121; Fletch., 54, XXIV, 1892, 23, Fig. 1; Doran, 47, XXIV, 1892, 270; Bl., 5, 1892, 130; Id., 16, 1899, 223, Fig. 54; Bent., 3, VI, 1894, 264; Lugg., 84, 1898, 257, Fig. 167b.

Gryllotalpa brevipennis Serv., 196, 1839, 368; Harris, 62, 1862, 149, Fig. 68; Rathv., 109, 1862, 378, Fig. 12.

Gryllotalpa longipennis Scudd., 141, VII, 1862, 426.

Gryllotalpa columbia Scudd., 145, I, 1869, 26, Plate I, Figs. 15, 36; Bent., 3, VI, 1894, 264, Plate V, Fig. 5; Lugg., 84, 1898, 257, Fig. 167.

Gryllotalpa columbiana Bl., 5, 1892, 131.

Color: Cinnamon brown, covered with short, fine hairs of the same hue; claws and veins of tegmina darker.

Tegmina covering one-half to three-fourths of abdomen. Inner wings slightly exceeding tegmina in short winged form, extending beyond tip of abdomen in long winged form (*columbia* Scudd.).

Measurements: Length of body, 30 mm.; of pronotum, 9 mm.; of tegmina, 9-12 mm.; of hind femora, 7.5 mm.; of cerci, 11 mm.

The northern mole cricket has been taken by the writer in Marshall, Starke, Kosciusko, Putnam, Clinton, Vigo, Tippecanoe, Marion and Monroe counties, and doubtless occurs throughout the State, as it is found over the United States and Canada east of the Rocky Mountains. About one-third of those noted in the State are of the long winged form. On one occasion a log deeply buried in the sand on the southern shore of Lake Maxinkuckee was overturned and nine specimens were secured. Of these, however, six were long winged and three short winged.

In the moist mud and sand along the margins of the smaller streams and ponds the runs or burrows of this cricket, exactly like those of a mole though much smaller, can in late summer and early



Fig. 104. *Gryllotalpa borealis* Burm. Long-winged Male.

autumn be seen by those interested enough to search for them. The burrows are, in the main, very superficial, lying just beneath the surface and running in very irregular directions. They frequently fork, and often end beneath a stone or small stick. The insects themselves are seldom seen, as they are nocturnal, forming their burrows by night, and scarcely ever emerging from beneath the ground. Moreover, like a mole, they move backward as readily as forward, and so easily escape their enemies. Apparently one insect, or a single pair occupy these burrows; the males, though several are often heard at the same time, being usually at quite a distance apart.

The burrows occasionally enlarge into side cavities large enough for the insect to turn around, and in such lateral chambers the eggs are sometimes found in masses of 60 to 100, adhering to the rootlets of various plants. These eggs are spherical, white or almost colorless, and have a diameter of 0.7 mm. The young are active leapers, and are said to be about three years in reaching maturity. On July 19, 1894, a hundred or more of the half-grown young were captured in a small meshed seine while collecting fishes in a small stream in Montgomery County. They were evidently burrowing in the soft mud close to shore or perhaps in the mud beneath the shallow water. Just a year later a number of young were also taken in a seine from the waters of the outlet of Lake Wawasee, Kosciusko County. Since they feed, during their lives, mainly upon the tender roots of various plants, they are necessarily very injurious and it is fortunate that with us they are not more common than they are.

The note of the male mole cricket is a sharp di-syllabic chirp, continuously repeated and loud enough to be heard several rods away. It is usually attributed, by those who have given little attention to insect sounds, to the field cricket or to some of the smaller frogs. The cricket is very difficult to locate by this note, and the writer has on several occasions approached cautiously, on hands and knees, a certain spot, and has remained silent for several minutes while the chirping went on apparently beneath his very eyes; yet, when the supposed exact position of the chirper was determined and a quick movement was made to unearth him, he could not be found. Indeed, it is only by chance, as by the sudden turning over of a log in a soft mucky place, that a person can happen upon one of them unawares. Even then quick motion is necessary to capture him before he scrambles into the open mouth of one of the burrows which he has ever in readiness. I have heard their note in the forenoon of cloudy days, but it is much more common in the afternoon, and Mr. Seudder, who has given especial attention to the sounds of insects,

has written of it as follows: "Our common mole cricket usually begins its daily chirp at about four o'clock in the afternoon, but stridulates most actively at about dusk. On a cloudy day, however, it may be heard as early as two or three o'clock; this recognition of the weather is rather remarkable in a burrowing insect, and the more so as it does not appear to come to the surface to stridulate, but remains in its burrow, usually an inch below the surface of the ground. Its chirp is a guttural sort of sound, like *grü* or *greeu*, repeated in a trill indefinitely, but seldom for more than two or three minutes, and often for less time. It is pitched at two octaves above middle C, and the notes are usually repeated at the rate of about 130 or 135 per minute; sometimes, when many are singing, as rapidly as 150 per minute. Often, when it first begins to chirp, it gives a single prolonged trill of more slowly repeated notes, when the composite character of the chirp is much more readily detected, and afterward is quiet for a long time. When most actively chirping, however, the beginning of a strain is less vigorous than its full swell, and the notes are then repeated at the rate of about 120 per minute; it steadily gains its normal velocity. It sounds not unlike a feeble distinct croak of toads at spawning season."

LII. TRIDACTYLUS Olivier (1789).

To this genus and the next belong the "sand crickets" which are among the smallest of the Gryllidæ, no one of the three species found in the United States being more than 10 mm., or two-fifths of an inch in length. The principal distinguishing characters of the genus are given in the key to the genera of *Gryllotalpinæ*.

The fore tibia of the males of *Tridactylus* has been shown by Morse to vary much in structure. It is usually more "or less irregularly ovate in outline and terminating apically in four prominent equidistant teeth, with the convex outer face thickly set with hairs, * * * the tarsus being inserted between the first and second teeth and lying on the anterior face." From this normal form it varies in progressive degree to a remarkably bifurcate organ in which the inner limb is elongated and devoid of hairs, the innermost tooth nearly disappears, the second is greatly prolonged into a claw-like organ, while the femur acquires tooth-like projections on its upper, inner ventral angle and becomes greatly enlarged. The outer wings or tegmina are horny and opaque and do not reach the end of the abdomen, while the inner wings are longer and folded lengthwise like a fan. The hind femora are much enlarged and the insects are active leapers.

"These sand crickets," says Scudder, "are in general appearance, miniature *Gryllotalpas*, though, not being heavy bodied, they can leap vigorously, bounding high in the air. Nothing is more curious than these lively and pigmy mole-crickets; they live in similar places, and make burrows like the mole-crickets, but their forelegs, though constructed for burrowing, are very different in detail. They are not, however, found in quite such wet spots as the mole-cricket haunts, preferring the sandy margins of ponds rather than muddy ones. Their burrows are at first vertical, but immediately turn, running not more than an inch below the surface of the ground, and are very narrow, as would be expected of such little creatures; one measured was hardly a twentieth of an inch in diameter. The males are not provided with any tambourine upon the wings, and therefore can not sing."

But one species of *Tridactylus* is known from Indiana.

121. *TRIDACTYLUS APICALIS* Say. The Larger Sand Cricket.

Tridactylus apicalis Say, 138, IV, 1825, 310; Id., 139, II, 1859, 239; Scudd., 141, VII, 1862, 425; Id., 188, 1900, 86; Id., 195, IX, 1902, 309; Pack., 104, 1883, 563; Riley, 122, II, 1884, 180; Bl., 5, 1892, 129; Lugg., 84, 1898, 259, Fig. 168.

Xya mixtus Hald., 65, VI, 1853, 364.

This is the largest of the three species of sand crickets occurring in the United States, its length being 8 or 9 mm. The body is black or dark brown, the head and thorax with some white markings, and the tegmina with their outer edge and a spot behind the middle white. The hind femora are whitish with the upper half of outer face brownish or with three dark cross-bars. The wings of the male extend 3 mm. beyond the tip of the abdomen. The fore tibiae of the males of Indiana specimens I find to vary in like manner as those of *T. terminalis* mentioned by Morse.



Fig. 10. *Tridactylus apicalis* Say.
(After Lugg.)

Measurements: Length of body, 9 mm.; of tegmina, 3 mm.; of inner wings, 7.5 mm.; of posterior femora, 5 mm.

Apicalis has been noted in Indiana only in Putnam and Vigo counties. In the former it was taken in numbers in August, 1893, and again in June, 1894, from a damp sandbar along Walnut Creek, two miles east of Bainbridge. Both here and in Vigo County it was in company with the next species. It occupied small pits or burrows in the sand, and would sometimes be seen resting with the head and half the body outside the opening of the pit, into which it backed as

one drew near. Usually, however, it was at a distance from any visible pit and would then leap vigorously when approached, often to a height of five feet and a distance twice as great. By close search it will probably be found to occur along damp sandbars in all portions of the State, as its general range includes the United States east of the Great Plains.

LIII. ELLIPES Scudder (1902).

This genus was but recently separated from *Tridactylus*. The main distinguishing characters are given in the key. But one species, *E. minuta* (Scudder), ranging from Minnesota to Cuba and Mexico, and from Indiana to California, is known from the United States.

122. ELLIPES MINUTA (Scudder). The Smaller Sand Cricket.

Tridactylus minutus Scudd., 141, VII, 1862, 425; Id., 188, 1900, 87; Lugg., 84, 1898, 259.

Ellipes minuta Scudd., 195, IX, 1902, 309; Bl., 18, 1902, 129, 223.

General color a dark brown or black; middle femora and tibiae and posterior femora with narrow white crossbars. Pronotum and segments of abdomen with their hind margins whitish. The wings cover about three-fourths of the abdomen; the tegmina, half of the wings.

Measurements: Length of body, 5 mm.; of hind femora, 3.5 mm.

In Indiana this small sand cricket has been taken in Spencer, Vigo, Putnam and Lake counties. It frequents damp sandy places which are sparsely covered with grass or other vegetation, where it is often found in company with the grouse locusts or with the larger sand cricket, *Tridactylus apicalis* Say. While more active in its movements it does not leap as high nor as far as that species. The best way to capture them, after discovering a colony, is to sweep rapidly just above the ground with a net of cheese cloth or other close meshed material.

Sub-family MYRMECOPHILINÆ.

The Indiana members of this sub-family are very small, sub-spherical crickets, which bear a general resemblance to the young of cockroaches but leap actively when disturbed. They live with colonies of ants in or beneath rotten stumps and logs and under stones. They belong to the single genus, *Myrmecophila*, characterized as follows:

LIV. MYRMECOPHILA Latreille (1807).

Body sub-spherical or ovate, greatly convex above, wingless. Eyes very small, resembling ocelli. Antennæ rather stout, as long as the body. Occiput almost hidden by the pronotum, which is large, wider behind than in front, the anterior and posterior margins straight; meso and metanotum, similar to the segments of the abdomen, sometimes a little wider. Anterior tibiæ without hearing organ, unarmed. Hind femora, ovate, greatly enlarged. Hind tibiæ stout, shorter than femora, compressed, the upper margin ciliate; the inner carina with four movable spines, the outer with two; the apex with three or four rather long, terminal spurs. Cerei as long as or longer

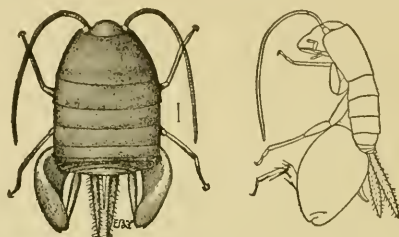


Fig. 106. *Myrmecophila nebrascensis* Brun. (After Lugger.)

than the abdomen. Ovipositor short and stout. The male is more slender and smaller in size than the female.

A very interesting account of the habits of these little crickets has been published* by W. M. Wheeler, of Austin, Texas, from which I quote at length as follows: "My observations on the habits of *Myrmecophila* began early in the March of the present year. The little crickets were taken from the *Formica* or red ants' nests and placed in artificial nests of the agricultural ant, an insect of much larger size, slower movements and in many other respects more satisfactory for purposes of observation than the *Formica*.

"On April 3d I placed in the artificial nest twenty *Myrmecophilas*, eight or ten of which had been squeezed or had lost one or both saltatory legs during capture. All the disabled individuals were at once seized and dispatched in so vindictive a manner, that I could not doubt that the ants were irritated by the pungent red ant nest-odor still clinging to the crickets. In an instant all the ants in the compartment of the nest had gathered in little groups, each devouring a *Myrmecophila*. The uninjured crickets made not the slightest attempt to escape, but felt themselves perfectly at home as soon as

* *Psyche*, IX, 1900, p. 111, *et seq.*

they set foot on the floor of the nest. Their adaptation to a new nest and to an ant of a larger size and belonging to an entirely different sub-family from their former host, was immediate and complete. With constantly vibrating antennæ they began dodging in and out among the little groups of assembled ants. From time to time one of them would be seen cautiously approaching an ant, that was busy with its dinner of *Myrmecophila*, and fall to nibbling at its legs or the tip of its abdomen. There could be no doubt that the cricket derived some benefit from the oily secretion covering the surface of the ant's body. At first the ant disregarded this nibbling, which probably resembles the attentions of the toilet habitually received from sister ants, but the cricket's scraping mandibles and maxillæ soon grew annoying and the ant would either move away or turn its head, open its mandibles and make a lunge at the *Myrmecophila* like a large dog annoyed by a puppy. But before the huge mandibles had closed, the cricket was far away, already nibbling at the abdomen of some other ant. The cricket can get at only the legs and abdomen of its host, since the spreading legs prevent it from reaching the thorax. It often stands on its hind legs, and places its forelegs on the ant's leg, in order to reach the femur or tibia. For very obvious reasons, it avoids nibbling at or even approaching the ant's head. It is always alert, as if perpetually aware of danger and ready to dodge at the slightest movement made by the ant.

"Occasionally in the narrow confines of an artificial nest the ants do succeed in capturing and devouring one of their vigilant little guests, but the fact that of the eleven sound crickets left after the above observation was made, eight were still alive June 22d, when I had to discontinue my observations for the summer, shows that the crickets are extremely expert in keeping out of danger. The attitude of the ants during all this time underwent no change as far as I could observe, for they would still occasionally make lunges at the crickets.

"The crickets do not derive all their substance from cleansing their hosts. In earthen nests they are often seen haunting even the galleries that have been abandoned by the ants, scrutinizing the walls and nibbling at them from time to time. There can be no doubt that they find here the same substance which covers the ants, for the walls of the galleries of a populous nest soon become greasy from the attrition of the constantly passing ants. Sometimes the crickets may be seen nibbling at dead ants that have been temporarily abandoned in the galleries or placed on the kitchen-midden of

the nest. The intestine of a *Myrmecophila* which I dissected was found to contain oil-globules and a granular whitish substance."

Five species of *Myrmecophila* are known from the United States. Of these but one occurs east of the Mississippi River, and it was known only from Maryland, Georgia and the District of Columbia until 1901, when it was found in numbers in southern Indiana.

123. *MYRMECOPHILA PERGANDEI* Bruner.

Myrmecophila pergandei Brun., 21, XVI, 1884, 42, Fig. 4; Riley, 122, II, 1884, 181; Scudd., 187, VIII, 1899, 424, 425; Id., 188, 1900, 87.

Color: Dark reddish brown, the front and hind margins of pronotum, the hind margins of the other dorsal segments as well as the apex of ovipositor, a darker piceous brown; the legs, cerci and base of antennæ and ovipositor a paler brown. The young are generally paler than the adults.

Body broad oval, depressed; nearly twice as long as broad; hind femora pyriform, more arcuate below than above. Ovipositor rather stout, straight, the inner valves a little shorter than the outer.

Measurements: Length of body, male 3-4 mm., of female, 4-5 mm.; of hind femora, female, 3 mm.; of ovipositor, 2.5 mm.

This small ant-loving gryllid was first taken in Indiana near New Harmony, Posey County, on April 26, 1901. It was afterward found to be rather common in the region thereabouts as well as in Knox, Perry, Dubois, Crawford, Orange and Lawrence counties; the northernmost point at which it has been observed being near Mitchell, Lawrence County. Since its known general range is southern it probably does not occur in the northern half of the State. With us it is found in company with a half dozen species of ants, the most common of which is a rather large yellowish-red form, probably *Camponotus melleus* Say. The cricket seems to be always on the move, and when disturbed leaps with great agility. Those taken in Crawford County in September were almost double the size of those noted in the spring and probably more accurately represent the mature insect. But little is as yet known of the life habits of these interesting insects and the subject is well worthy of prolonged observation.

Sub-family GRYLLINÆ.

This sub-family comprises the ground and field crickets. They are among the most common members of the order Orthoptera; abounding everywhere in temperate and torrid climates. The main

distinguishing characters of the sub-family are given in the key. Many of the species are dimorphic as regards the length of the wings, and on this account much confusion in synonymy has resulted in the past. But three genera of the sub-family occur in the United States, all of which are represented in Indiana. These genera may be distinguished by the following key:

KEY TO GENERA OF INDIANA GRILLINÆ.

- a.* Species of small size; last joint of the maxillary palpi double the length of the one preceding; hind tibiæ furnished with long, movable, pilose spines; first joint of hind tarsi unarmed above or with one row of small teeth.....LV. NEMOBIUS, p. 419
- aa.* Species of medium or large size; last joint of maxillary palpi but little, if any, longer than the one preceding; hind tibiæ armed with stout, immovable spines; first joint of hind tarsi sulcate above, with a row of teeth on each side.
 - b.* Species of large size; fore tibiæ provided with a hearing organ on both faces.....LVI. GRILLUS, p. 429
 - bb.* Species of medium size; fore tibiæ with hearing organ on outer face only.....LVII. MIOGRILLUS, p. 442

LV. NEMOBIUS Serville (1839).

Of all the Gryllidæ which occur with us, the little brown ground crickets of the genus *Nemobius* are the most numerous and the most social. Unlike their larger cousins, the field crickets, they do not wait for darkness before seeking their food, but wherever the grass has been cropped short, whether on shaded hillside or in the full glare of the noonday sun along the beaten roadway, mature specimens may be seen by hundreds during the days of early autumn. Even the tangled masses of sphagnum mosses and other semi-aquatic growth of fen and marsh furnish shelter and food to certain species which, in the ages of the past, have become adapted to a life of such surroundings.

These ground crickets are all of small size, being never more than half an inch in length. The color is usually a dark brown or pitch black, and the bodies and legs are sparsely clothed with brown hairs. The head and thorax are of nearly equal breadth. The last segment of the maxillary palpus is twice the length of the one preceding it, and enlarged at the outer end. The anterior tibiæ bear near their base a small oval hearing organ on the outer face. The veins of the wing covers of the female run lengthwise, while in the females of the larger field crickets they run obliquely from both sides.

While the individuals of *Nemobius* are so plentiful, their size is so small that they have received but little attention from the average collector. Moreover, so similar in general appearance are they that very close observation by the student is necessary to separate the species one from another. As a consequence but 15 have hitherto been described from the whole United States. Up to May, 1900, when the writer described three new species from Indiana* but three had been accredited to the States north of Florida and east of the Rocky Mountains. McNeill listed but one from Illinois. Bruner mentions three, two without names, from Nebraska, while Scudder, in his most recent paper on the group, accredits three, viz.: *N. fasciatus*, *N. cubensis* and *N. carolinus* to the central and eastern States.

Within the past ten years many specimens have been collected in different parts of Indiana. A careful study of these reveals the presence of at least eight species. There is little doubt but that the right kind of investigation will show the presence of as many or more in almost any State east of the Rocky Mountains. Those known to occur in Indiana may be separated by the following key:

KEY TO INDIANA SPECIES OF NEMOBIUS.

- a. Ovipositor as long as or barely shorter than the hind femora; straight or nearly so.
 - b. Ovipositor distinctly longer than hind femora; cross-veinlets of tegmina of female very prominent; black of body arranged in lengthwise bars.
 - c. Color blackish or fuscous; the dark stripes on occiput always visible, though sometimes indistinct in very dark specimens124 *fasciatus*, p. 421
 - cc. Color light reddish brown or grayish; without dark stripes on occiput125 *canus*, p. 423
 - bb. Ovipositor no longer than hind femora; cross-veinlets of female tegmina not prominent; black of body scattered in blotches and dashes126 *maculatus*, p. 424
- aa. Ovipositor distinctly shorter than hind femora; usually more or less arcuate.
 - d. Tegmina of female nearly or quite as long as abdomen; wings generally twice as long as tegmina127 *cubensis*, p. 425
 - dd. Tegmina of female shorter than abdomen, wings wanting.
 - e. Tegmina of males reaching tip of abdomen, their ground color yellowish brown.
 - f. Dorsal field of pronotum and all the legs a uniform brownish yellow; tegmina of males wider than abdomen128 *criguus*, p. 426

* Psyche, IX, 1900, p. 51, *et seq.*

- ff. Dorsal field of pronotum and all the legs more or less mottled with black; tegmina of males no wider than abdomen.....129 *carolinus*, p. 427
- cc. Tegmina of males covering only two-thirds to three-fourths of abdomen, their color wholly black or very dark brown.
- g. Length of body of female less than 6.5 mm.; last two joints of maxillary palpi of female dark brown; inner face of hind femora of male not barred with black.....130 *palustris*, p. 427
- gg. Length of body of female more than 7 mm.; last two joints of maxillary palpi of female white; inner face of hind femora of male barred with black....
131 *confusus*, p. 428

124. NEMOBIUS FASCIATUS (DeGeer). The Striped Ground Cricket.

Gryllus fasciatus DeG., 57, III, 1773, 522, Plate 43, Fig. 5.

Nemobius fasciatus Scudd., 141, VII, 1862, 430; Id., 175, IV, 1896, 100, 102; Id., 176, VII, 1896, 432; Id., 188, 1900, 88; Glov., 62, 1872, Plate VI, Fig. 13; Sauss., 132, VI, 1874, 389; Id., 133, II, 1877, 242; Bl., 5, 1892, 136; Id., 16, 1899, 227, Fig. 56; Id., 17, IX, 1900, 51; Beut., 3, VI, 1894, 266, Plate V, Fig. 9; Lugg., 84, 1898, 261.

Acheta vittata Harr., 72, 1862, 152, Fig. 70; Rathv., 109, 1862, 380, Fig. 16.

Nemobius vittatus Scudd., 141, VII, 1862, 430; Id., 142, II, 1868, 115, 120 (song of to music); Id., 148, 1874, 364 (chirp set to music); Glov., 62, 1872, Plate III, Figs. 9, 10; Sauss., 132, VI, 1874, 389; Pack., 104, 1883, 564; Comst., 41, I, 1888, 121; Bl., 5, 1892, 135.

Nemobius fasciatus vittatus Beut., 3, VI, 1894, 267, Plate V, Fig. 10; Lugg., 84, 1898, 262, Fig. 170; Bl., 17, IX, 1900, 52.

Nemobius exiguus Scudd., 141, VII, 1862, 429.

Two forms of this, our largest and most common *Nemobius*, occur in Indiana. In one (*fasciatus*) the tegmina reach to the end of the abdomen while the inner wings extend to the tip of ovipositor. In the other (*vittatus*) the tegmina of the female cover a little more than half the abdomen and their cross-veinlets are coarser and much more prominent than in *N. maculatus*. Those of the male cover three-fourths of the abdomen. In this form the inner wings are wholly wanting in both sexes. As in most of the other species the head and thorax bear many coarse, stiff black hairs. The ovipositor is longer than in any other Indiana species, being about one-eighth longer than the hind femora.

The short winged form varies in color from a dusky brown to a rusty black. When of the latter hue the black stripes on the head, to

which it owes its varietal name, are very dim or wholly invisible. The long winged form is always black.

Measurements: Length of body, male, 10 mm., female, 11 mm.; of pronotum, male and female, 3 mm.; of tegmina, male, 5.5 mm., female, 4 mm.; of wings, long-winged form, 13 mm.; of hind femora, male and female, 7.5 mm.; of ovipositor, 8.5 mm.

No intermediate short winged forms connecting *fasciatus* with *vittatus* have been seen by me, nor have any been recorded to my knowledge. The two are, however, regarded as dimorphic forms of the same species by the leading authorities, Sausure and Sender.

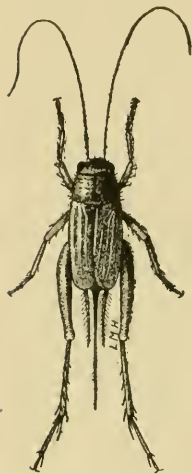


Fig. 107. *Nemobius fasciatus* (DeG.). Female. Short-winged form. (After Luger.)

During hundreds of days spent in field collecting not a single specimen of the long winged form was taken until August 1, 1902, when it was found in numbers on the stems of long grass in a marsh bordering Round Lake, Whitley County. Many, however, have been taken from the walks and streets of Indianapolis, Fort Wayne and other cities and towns in the northern part of the State, but none, as yet, in the southern half, not even in Terre Haute, where I resided for seven years. Where the insect breeds, and feeds by day is to me unknown. It appears to reach maturity about July 15th and, at times, as in the first week in August, 1899, swarms composed of myriads have

appeared about the lights of some of the cities. The newspapers the next day had a column or more devoted to the insects but nothing, except wild guesses, as to whence they came.

The short winged form *vittatus* begins to reach maturity in central Indiana about July 15th. Living specimens have been seen as late as December 1st. Although present in vast numbers, but little is known of its life habits. When disturbed they are very difficult to capture, making enormous leaps with their stout hind legs, no sooner striking the ground than they are up again, even if not pursued, until they find a leaf or other shelter beneath which to take refuge.

They appear to be omnivorous, feeding upon carrion, cow dung and grasses with equal avidity. Though small in size, their enormous numbers as well as the fact that they are constant, greedy feeders from the time the eggs hatch in spring until laid low by the hoar frost of autumn, renders them particularly injurious. The aggregate

damage which they cause to grass and kindred plants in the course of a single season must be great, and there is little doubt but that this, as well as the other species of the genus, should be classed among those insects highly destructive to forage plants.*

Mr. S. H. Scudder has given the following pleasing account of the sounds made by this species: "The chirping of the striped cricket is very similar to that of the black field cricket; and may be expressed by *r-r-r-u*, pronounced as though it were a French word. The note is trilled forcibly, and lasts a variable length of time. One of these insects was once observed while singing to its mate. At first the song was mild and frequently broken; afterwards it grew impetuous, forcible and more prolonged; then it decreased in volume and extent until it became quite soft and feeble. At this point the male began to approach the female, uttering a series of twittering chirps; the female ran away, and the male, after a short chase, returned to his old haunt, singing with the same vigor but with more frequent pauses. At length, finding all persuasions unavailing, he brought his serenade to a close."

125. *NEMOBIUS CANUS* Scudder.

Nemobius canus Scudd., 175, IV, 1896, 100, 103; Id., 176, VII, 1896, 432; Id., 188, 1900, 88.

Size, large; the head prominent, both it and the thorax sparingly beset with black bristles. Head reddish or yellowish brown in color; sparingly or not at all marked with fuscous and without trace of black bars on occiput. Eyes shorter, smaller and more globose than in *N. fasciatus*. Antennae and palpi yellowish brown. Pronotum broader than long, the sides a little convex; yellowish brown in female, darker in male, the sides in latter with a fuscous bar on their posterior half. Tegmina of male covering three-fourths of abdomen, yellowish brown above, darker on basal third, the sides with a shining piceous bar along their upper third; those of female covering half or a little more of abdomen, the stripe on sides narrower and less shining than in male, sometimes with an additional one on dorsal field. Abdomen reddish brown with a median dark stripe on dorsal surface, and a similar one along each side. Hind femora short and very stout, a uniform reddish brown, sometimes darker in the male. Ovipositor distinctly longer than hind femora, straight or nearly so, the tip acute, the serrated portion short, the teeth sharp, not crowded.

* For other accounts of the destruction wrought by the species of *Nemobius* see Rathvon, U. S. Agricultural Report, 1862, p. 380, and Osborne's Bulletin, 23, U. S. Division Entomology, p. 59.

Measurements: Length of body, male, 8.5 mm., female, 12 mm.; of pronotum, male, 2.5 mm., female, 3 mm.; of tegmina, male, 6.5 mm., female, 5 mm.; of hind femora, male, 7.5 mm., female, 8.5 mm.; of ovipositor, 9.5 mm.

This is a southern species heretofore known only from Texas, which occurs sparingly throughout southern Indiana, being most abundant in the counties bordering the Ohio River. Our specimens differ from types from Texas in having smaller eyes, and in being yellowish brown rather than grayish in hue. Specimens were sent to Professor Morse for comparison with Scudder's type, and by him pronounced the same. In Crawford County the species frequents roadsides and high dry open fields and meadows. From the short winged form of *fasciatus* it may at once be separated by the lighter color, unstriped occiput, smaller, more globose eyes and shorter hind femora.

126. *NEMOBIUS MACULATUS* Blatchley. The Spotted Ground Cricket.
Nemobius maculatus Bl., 17, IX, 1900, 52.

Size, medium; head rather prominent, dark reddish brown, more or less dotted with pitch black, especially on forehead and cheeks; eyes rather large, prominent. Antennæ dull yellowish brown, the basal third lighter; maxillary palpi of the same color, the apical half of terminal joint darker. Pronotum broader than long, faintly tapering anteriorly; the dorsal field chestnut brown with numerous dark points; the front margin and lateral field sparingly beset with stiff black bristles. A black stripe starts back of the eye and covers the upper two-thirds of lateral field of both pronotum and tegmina. The latter with a yellowish vein separating the dorsal and lateral fields, more prominent in the male. The dorsal field brownish yellow, sometimes with blackish dots; in female covering one-third of abdomen, in male, two-thirds; wings absent. Legs and dorsal surface of abdomen brownish yellow sprinkled with fuscous, which on dorsal surface of hind femora is sometimes in crossbars. Ovipositor almost straight, equaling in length or very slightly shorter than hind femora; the apical blades rather long, tapering evenly to a fine point; above, evenly and sharply serrulate.

Measurements: Length of body, male, 7 mm., female, 8 mm.; of pronotum, 2.5 mm.; of tegmina, male, 4 mm., female, 2.8 mm.; of hind femora, male, 5.5 mm., female, 6.5 mm.; of ovipositor, 6.5 mm. Width of pronotum, 3 mm.

N. maculatus is readily distinguished from the short winged form of *N. fasciatus* by its average smaller size, shorter tegmina of female,

shorter and straighter ovipositor, fewer hairs on head and pronotum and finer cross-veinlets of female tegmina. The serrulations of the ovipositor are sharper than in *fasciatus*. The two also differ in color, the ground of *maculatus* being lighter and the piceous more generally sprinkled where in *fasciatus* it is in lengthwise bars. *Maculatus* has, as yet, been taken in small numbers only in Marion and Vigo counties. It is found in low open woods, usually in the vicinity of or beneath logs.

127. *NEMOBIUS CUBENSIS* Saussure.

Nemobius cubensis Sauss., 132, VI, 1874, 384, Plate 7, Fig. 5; Scudd., 175, IV, 1896, 100, 105; Id., 176, VII, 1896, 432; Id., 188, 1900, 88; Bl., 17, IX, 1900, 54.

Nemobius volaticus Scudd., 160, XIX, 1877, 36; Id., 161, VI, 1878, 14.

Head rather full and convex, projecting above the surface of the pronotum, black, with bristly hairs; antennæ dark brown, the margins of its segments paler; palpi varying irregularly from pallid to dusky, the terminal joint nearly twice as long as the third, and about three times longer than the fourth. Pronotum black, broader than long, slightly broader behind than in front, the anterior half or more with a distinct median furrow, the whole surface with scattered black bristles. Tegmina narrow, nearly as long as the abdomen, pitch black in color; wings very long, the tip of the closed tegmina lying midway between the tip of the wings and the front of the head. Legs brownish yellow, more or less infuscated, especially above, the hind femora rather slender, the tibial spines slightly paler at tip. Cerci slender, dusky, about as long as the hind tibiæ; ovipositor very much as in *N. carolinus*; dark brown, similarly armed at tip.

Measurements: Length of body, male, 6.5 mm., female, 6.75 mm.; of antennæ, male, 13 mm., female, 14 mm.; of tegmina, male, 4 mm., female, 4.4 mm.; of hind femora, male, 5 mm.; of hind tibiæ, male, 3.75 mm., female, 3 mm.; of ovipositor, 3 mm.

I have not seen the females from Indiana and the above description is therefore copied in part from Scudder. Two males distinct from any others found in the State were taken October 9, 1893, from the sandy bed of the old canal north of Terre Haute, Indiana. They were sent to Mr. Scudder, who pronounced them the short winged form of *N. cubensis*. In life they were shining black with a bright yellow line separating the dorsal and lateral fields of the tegmina. The general range of *cubensis* is southward; it having been recorded from a number of the Gulf States as well as Cuba and Brazil, South America. Scudder records two females as having been taken in Illinois.

128. *NEMOBIUS EXIGUUS* Blatchley.*Nemobius exiguus* Bl., 5, 1892, 136; Id., 17, IX, 1900, 53.

Size, medium; body, slender; head rather large, but slightly tumid. Eyes small but prominent. Antennæ, head, pronotum and femora brownish yellow. Maxillary palpi light yellow throughout or with the apical third of terminal joint infuscated. Tegmina of male reaching tip of abdomen; the dorsal field expanded so that they extend beyond the sides of abdomen; brownish yellow in color with a narrow piceous bar on upper third of lateral field and with basal third of dorsal field often more or less pitch black. Tegmina of female covering one-half or more of abdomen, the dorsal field usually heavily shaded with blackish; wings absent in both sexes. Upper surface of abdomen blackish, lower surface brownish yellow or luteous. Ovipositor a third or more shorter than hind femora, distinctly arcuate, the apical blade not enlarged at the base, armed above with very small and rather dull teeth, which are irregularly distant one from another.

Measurements: Length of body, male, 7 mm., of female, 7.5 mm.; of tegmina, male, 5 mm., of female, 4 mm.; of hind femora, male, 5.2 mm., of female, 6.3 mm.; of ovipositor, 3.5 mm.

This is the "*N. exiguus* Scudder" of my paper on the "Gryllidæ of Indiana," *loc. cit.* It appears, however, that Scudder had not described a species as *exiguus* but had merely mentioned a form of *N. fasciatus* under the name. Bentenmuller afterwards* described *N. affinis* from New York, which he stated was the insect mentioned by me, but which, according to Scudder,† is *N. carolinus*.

Exiguus is longer and proportionally more slender than the next species, *N. carolinus* Scudd., though the tegmina of the male are broader. The pronotum and femora are not mottled or marked with fuscous as in that species. The serrations of the ovipositor of *carolinus* are smaller, sharper and more evenly separated than in *exiguus*. The latter species occurs in all parts of the State and is fully one-half as common as the short winged form of *N. fasciatus*. Its habits, time of appearance and local habitat are also essentially the same. However, the smaller size, short ovipositor, yellowish maxillary palpi, and other differences in color, readily distinguish it from that insect.

* Bulletin American Museum Natural History, VI, 1894, pp 250, 267, Plate V, Fig. 11.

† Journal New York Entomological Society, IV, 1896, 107.

129. NEMOBIUS CAROLINUS Scudder.

Nemobius carolinus Scudd., 160, XIX, 1877, 36; Id., 161, VI, 1878, 14;
Id., 175, IV, 1896, 100, 107; Id., 176, VII, 1896, 433; Id.,
188, 1900, 88; Bl., 17, IX, 1900, 53.

Cyrtorhynchus variegatus Brun., 29, III, 1893, 32.

Nemobius affinis Beut., 2, VI, 1894, 249; Id., 3, 267, Plate V, Fig. 11.

Head and antennæ varying from dull yellow to dusky brown, furnished with rather long, curving, distant, black, bristly hairs. Pronotum of the color of the head, but more or less mottled with blackish, a little broader than long, supplied with long bristly black hairs, its anterior two-thirds with a distinctly impressed median line. Tegmina brownish yellow, the upper third of lateral field with a blackish bar; the dorsal field often with black fleckings; the mottled appearance sometimes due, however, to the black of dorsal surface of abdomen shining through them; those of the male rather ample and reaching the tip of the abdomen, those of the female covering but half of the abdomen; wings wanting. All the legs dull brownish yellow, more or less mottled with blackish; the tibial spines pale near the tip. Dorsal surface of abdomen of female with its basal two-thirds black; the last two or three segments brownish yellow with a sprinkling of small black spots. Cerci brownish, very slender, as long as the abdomen; ovipositor dark brown, a little upcurved, moderately stout, shorter than the hind tibiæ, the apical denticular field longer than usual and nearly equaling one-fourth the entire length of the ovipositor.

Measurements: Length of body, male, 7 mm., female, 8.5 mm.; of tegmina, male, 4.2 mm., female, 3.5 mm.; of hind femora, male, 5.3 mm., female, 6.2 mm.; of ovipositor, 3.8 mm.

This prettily marked little species has been found to be rather common on the grass covered banks of streams and along the fence rows of open woods in Vigo, Putnam and Monroe counties, and it probably occurs in like situations throughout the State. In general appearance it is a diminutive form of *N. maculatus* above described, but its small size and short arcuate ovipositor at once distinguish it. According to Scudder, *carolinus* ranges from New England to Nebraska and Texas.

130. NEMOBIUS PALUSTRIS Blatchley. The Marsh Ground Cricket.

Nemobius palustris Bl., 17, IX, 1900, 53.

Size, small; the body of male especially short and broad. Head tumid; eyes large, but not prominent. Pronotum one-third broader than long, the sides sub-equal, rather thickly beset with stiff black bristles, as are also the forehead and dorsal surface of the two front

femora. Head, tegmina and body of most specimens a uniform dark piceous; disk of pronotum piceous or fuscous sprinkled with piceous. Antennæ, legs and ovipositor fuscous. Maxillary palpi yellowish except the apical joint which is wholly piceous. Tegmina of female covering a little more than half the abdomen; those of the male hardly reaching its tip. Ovipositor almost a third shorter than hind femora, distinctly though feebly arcuate, the apical blades but little enlarged at the base, very finely serrulate with dull, rasp-like teeth.



Fig. 108. *Nemobius pavidus* Bl. Female. Three times natural size. (Original.)

Measurements: Length of body, male, 5.8 mm., female, 6.2 mm.; tegmina, male, 4 mm., of female, 3 mm.; of hind femora, male 4.5 mm., of female, 5 mm.; of ovipositor, 3.5 mm.

This handsome little pitch brown *Nemobid* has been found only among the tamarack swamps and cranberry bogs of the northern part of the State, where it finds a congenial home in the midst of the dense, damp sphagnum mosses. Sometimes they are so plentiful that a half dozen or more are seen in an area a foot square. Like the other members of the genus they are very active, when disturbed leaping vigorously, a few inches at a time, and finally seeking safety by burrowing in the masses of mosses. It has been taken in Marshall, Fulton and Starke counties and probably occurs wherever peat bogs and sphagnum mosses are present.

131. *NEMOBIUS CONFUSUS* sp. nov.

Body broad and rather stout; the head but little prominent; the face and antennæ fuscous in color; the vertex, disk of pronotum and two front pairs of femora with scattered, black, stiff hairs. Last two joints of maxillary palpi of the female white, very noticeable in living specimens; the same segments in the males whitish to fuscous, the apical half of terminal joint darker. Pronotum broader than long, with a median impressed line on its front half, more prominent in the female; the disk usually a dark smoky brown in color except along the front half of each lateral carina, where there are some light brown spots; the sides darker. Tegmina of female covering half, those of male, three-fourths of abdomen, piceous throughout except the carina separating the dorsal from the lateral field, which is fuscous or smoky brown. Dorsal surface of abdomen black, with often a few small dots of yellowish brown on the last three segments.

All the femora of female and the fore and middle pair of male fuscous, sometimes with a few lighter dots on their upper surface; the hind femora of male blackish on outer face, the dark color passing over the upper side and half way down the inner face where it is broken, thus forming bars or blotches plainly visible on the lighter color. The tibiae usually reddish brown, more or less mottled with fuscous. The basal joint of front tarsus whitish in the female. Ovipositor but little more than half as long as the hind femora, dark brown in color, its apical third wider and a little upturned; the armed portion longer than in any other Indiana species; the teeth fine, sharp, and more than usually distant one from another.

Measurements: Length of body, male, 7.2 mm., female, 7.5 mm.; of tegmina, male, 4 mm., female, 3 mm.; of hind femora, male and female, 6 mm.; of ovipositor, 3.3 mm.

This is a larger and broader insect than *N. palustris*. The main differences between the two species are set out in the key. The armed portion of the ovipositor is wider and longer and the teeth more distant and sharper in *confusus* than in *palustris*.

N. confusus has been taken in Kosciusko and Posey counties. In the former it was found on August 26, 1902, to be quite common in some low, damp woods bordering Tippecanoe Lake. Here it had its home among the fallen leaves and beneath small chunks and chips. From Posey County a single specimen was secured also from a tract of low woods.

It seems that the different species of this genus noted above have each a special abiding place. *Fasciatus* and *exiguus* are the only ones which may be looked for anywhere in open fields and along roadways. *Maculatus* occurs in open woods in dry situations; *cubensis* in sandy districts; *carolinus* along the banks of streams and on gravelly hillsides; *palustris* nowhere except among the sphagnum mosses of dense swamps and bogs, while *confusus* likes best the shadows of dense woods which are low and moist. Each species has, therefore, its special habitat where the food on which it thrives is most abundant, and where, during the ages past, it has become so modified in organ and hue as to receive from man a distinctive specific name.

LVI. GRYLLOUS Linnæus (1758).

To this genus belong those dark colored thick-bodied insects known as house and field crickets. The latter are the best known examples of the family Gryllidæ and are abundant from June 1st till after heavy frosts, beneath logs, boards, stones, and especially be-

neath rails in the corners of the old-fashioned and rapidly disappearing Virginia rail fences.

All members of the genus *Gryllus* have the head large and globose; the eyes large and rounded; the antennæ thread-like and longer than the body; the pronotum broader than long and about the width of the head; the hind femora of medium length but much enlarged and well-fitted for leaping; the hind tibiæ with two rows of strong fixed spines, those nearest the apex being the longer; and the hind tarsi with its first joint sulcate above with a row of minute teeth along each carina. The ovipositor is, in all the species, as long as or longer than the hind femora, and in the same species varies but little in length. Most of the species are, however, dimorphic as regards wing length, though among our Indiana species the short winged forms greatly outnumber the long winged ones. The inner wings vary much more than the outer and sometimes are wholly lacking.

Regarding the general habits of the field crickets Prof. Lawrence Bruner has written: "Usually most of our North American *Grylli* live singly or in pairs in burrows which they dig for themselves. These are used as retreats during the day time and serve as shelter from ordinary inclemencies of weather. These burrows are generally forsaken about midsummer for some sort of above-ground shelter. From this time on, until fall, they appear to be more social and live in colonies under various sorts of rubbish. Grain shocks are a favorite haunt for them, and since twine has been used for binding, the crickets have been quite troublesome by cutting the bands. During late summer and fall the females commence preparations for the continuance of their kind, by thrusting their long, slender ovipositors into the loose soil and dropping their eggs. These sometimes hatch the same year, but, as a rule, lie over until the following spring. The young generally live above ground, where they hide among fallen leaves, grasses and other debris, though sometimes they also creep into chinks and crevices in the earth."

The remarks of Mr. Bruner apply mostly to *G. abbreviatus*, one of our largest and only social species. The young of *G. pennsylvanicus* and *G. americanus* are, for the most part, hatched in autumn and survive the winter in the nymph stages, while *G. domesticus*, the house cricket, passes the winter either as adult or nymph.

The synonymy of the American species of this genus has become greatly confused, due largely to the fact that foreign writers have attempted to monograph the genus with but a limited number of specimens at hand; and again to the fact that the species, especially the males, are very difficult to separate.

Mr. Scudder, in two recent papers,* has in part straightened out this difficulty. However, he, as well as the European writers, has written mainly of specimens collected by others, and has not studied the insects in the field. For this reason Mr. Scudder has stated that but three species occur in the northern and central United States, east of the Mississippi River. A long series of observations in the field, coupled with a careful examination of a large number of individuals, has convinced me that at least six species occur in Indiana.† Of these, two are believed to be undescribed. The following key, based largely on the females, may be used in their separation:

KEY TO INDIANA SPECIES OF GRYLLUS.

- a. Black species, the tegmina and parts of the body sometimes dull reddish brown; first joint of antennæ not projecting beyond front of head. (Field crickets.)
 - b. Very large species, about 25 mm. long; the hind margin of pronotum convex; hind tibiæ with seven to eight spines on each side132 *firmus*, p. 432
 - bb. Medium or small-sized species, the body seldom exceeding 20 mm. in length; hind margin of pronotum truncate; hind tibiæ with five to six spines on each side.
 - c. Ovipositor but little, if any, longer than hind femora, never more than 12 mm. in length; tegmina of female with only their basal halves overlapping or attingent, the apical halves spread apart so as to leave a wide V-shaped notch between them.....133 *americanus*, p. 433
 - cc. Ovipositor plainly longer than the hind femora, always 13 or more mm. in length; tegmina of female with their inner edges either overlapping or attingent their full length.
 - d. Body slender; the pronotum never more than 5 mm. in width; the tegmina, cerci, ovipositor and legs reddish brown in color.....134 *arenaceus*, p. 434
 - dd. Heavy bodied species; the pronotum always more than 6 mm. in width; the tegmina, cerci, ovipositor and tibiæ black; the hind femora often with the basal half of the under side reddish brown.
 - e. Ovipositor nearly or fully half as long again as hind femora, always exceeding 18 mm. in length; the male stout, with large and broad head135 *abbreviatus*, p. 435

*"The Species of *Gryllus* on the Pacific Coast,"—Psyche, IX, 1901, 267, *et seq.*, and "The Species of *Gryllus* found in the United States East of the Sierra Nevadas,"—Psyche, IX, 1902, 291, *et seq.*

†Including *G. firmus* Scudder, of which, however, I have seen no specimen from this State.

- cc. Ovipositor seldom, if ever, more than 14 mm. or less than 13 mm. in length, rarely more than one-fourth as long again as hind femora; the male more slender, with narrower and less swollen head136 *pennsylvanicus*, p. 437
- aa. Straw-colored species, with some dark brown or blackish markings on head and thorax; first joint of antennæ projecting slightly beyond front of head. (House crickets).....137 *domesticus*, p. 439

132. *GRYLLUS FIRMUS* Scudder.

Gryllus firmus Scudd., 194, IX, 1902, 295.

Large and stout, with piceous body. Head large, tumid, with prominent vertex, scarcely broader than the pronotum, wholly black. Pronotum stout, black, most delicately margined anteriorly with reddish brown, broadest in advance of the middle, the sides being slightly and not quite uniformly convex, half as broad again as long, the front margin with scarcely perceptible concavity, the hind margin slightly but distinctly and broadly convex, with a median impressed line scarcely or not visible on posterior third, the lower margin of the lateral lobes oblique and nearly straight. Tegmina nearly or quite covering the abdomen, testaceous, more or less infuscated, often in the female with a clear testaceous humeral stripe, the mediastinal vein with three or four branches; wings generally no longer than the body, but sometimes caudate in the female. Legs reddish or yellowish brown, often more or less infuscated, the hind femora stout, the hind tibiae with generally six or seven rather long spines on the outer side, the upper inner calcar very long and almost as long as the intermediate calcar. Ovipositor fully a third longer than the hind femora.

Measurements: Length of body, male, 27 mm., female, 26 mm.; of pronotum, male, 5 mm., female, 5.5 mm.; breadth of pronotum, male and female, 7.5 mm.; length of tegmina, male and female, 14.5 mm.; of hind femora, male, 16 mm., female, 16.75 mm.; of ovipositor, 23.5 mm.

This is a species of southern range, specimens in Scudder's collection having come from North Carolina, Georgia, Florida and Texas. He also records one specimen from Brookville, Franklin County, Indiana, collected a number of years ago by Dr. Rufus Haymond. I have seen no specimens from this State, but have one from Agricultural College, Mississippi, collected in December by Mr. H. E. Weed. Nothing distinctive of its habits has been noted. It should be looked for throughout the southern third of the State.

133. *GRYLLUS AMERICANUS* sp. nov.*Gryllus neglectus*, Bl., 12, VII, 1895, 250. (Nec. Scudd.)

A shining black species, the female short-bodied and thick set, the male more slender. Head no broader than the pronotum, the vertex prominent; but sloping rapidly downward. Pronotum a little narrower in front than behind, its length contained in its greatest breadth 1.3 times; the median impressed line more than usually prominent, except upon its posterior fourth; the front margin truncate or a very little concave, the hind margin slightly sinuate and ciliate with black hairs. Tegmina of female covering two-thirds of abdomen, shining black, sometimes with a reddish brown tinge at base and along the humeral angle; their inner margins straight and overlapping or attingent only on their basal halves; the apical halves with the inner margin oblique or "bias" and when at rest therefore widely separated. Tegmina of male usually covering three-fourths of abdomen, rarely reaching its tip, the mediastinal vein with four branches. Wings represented by narrow thin scales. Hind femora short and stout, their lower and inner sides sometimes tinged with reddish brown on the basal third but never with the large reddish brown spot on lower side, so common in *G. abbreviatus* and *G. pennsylvanicus*. Hind tibiae dark chestnut brown, with five or six rather stout spines on the outer side. Ovipositor short, just equaling, or rarely exceeding by 1 mm. the length of hind femora, dark reddish brown in color, the apex paler.

Measurements: Length of body, male, 14 mm., female, 16.5 mm.; of pronotum, male, 3.5 mm., female, 4.2 mm.; of tegmina, male, 7.5 mm., female, 8 mm.; of hind femora, male, 10 mm., female, 11 mm.; of ovipositor, 11 mm. Width of pronotum, male, 5 mm., female, 5.6 mm.

This is the species which I formerly thought to be *G. neglectus* Scudder, but that authority states in his latest paper on the genus that *neglectus* is a synonym of *pennsylvanicus*. Moreover, I find that in his original description the average measurements of the ovipositor of *neglectus* are given as .28 of an inch, or 7 mm., whereas in *americanus* they are never less than 10 or more than 12 mm. in length. From *pennsylvanicus*, with which species it has been heretofore confused, *americanus* may be readily separated by its smaller

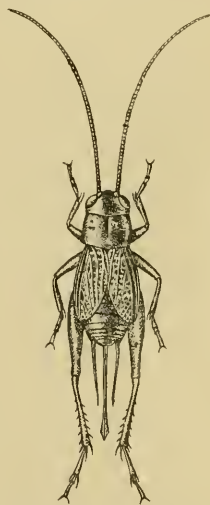


Fig. 109. *Gryllus americanus* sp. nov. Female. One and one-fourth times natural size. (Original.)

size, narrower pronotum, more uniform shining black color, shorter ovipositor, and the shape, and position when at rest, of the female tegmina. The reticulation of the dorsal field of these tegmina is more noticeable in *americanus* than in *pennsylvanicus*, the main diagonal nerves being closer together and the cross-nervules more elevated and prominent. *Americanus* reaches maturity in the spring about a fortnight the sooner.

Americanus has been taken in Crawford, Posey, Vigo, Putnam, Marion, Marshall, Wells and Lake counties, and probably occurs throughout the State. It is here the first species of *Gryllus* to become mature in the spring, the note of the male—the first Orthopteran song of the season—having been heard on a number of occasions in the central counties as early as May 5th. The young of this species, as well as of *G. pennsylvanicus*, survive the winter as nymphs. In September and October, after passing the second or third moult, they seek the shelter of loose bark on log or stump, or crawl beneath chunk or rail where they form for themselves small, inverted cone-shaped burrows in the earth, in which they abide until spring. Those which attempt to pass the winter with only a shelter of bark above them almost always succumb to the changing temperatures of that season, but those which choose more wisely a burrowing place beneath some half buried log or chunk for the most part survive. The temperature of their hibernaculum is much more equable, and the insects becoming sluggish in late autumn remain so until called into new activity by the sunshine of spring, unless, meanwhile, they fall a prey to some shrew mouse or other active winter insectivorous mammal. They emerge from their hiding places about April 1st, and after changing their garb two or three times, reach the mating stage in early May, when the males begin to greet the passer-by with their merry chirp.

Neither this species nor *pennsylvanicus* are social crickets. Sometimes two or three of the young have adjacent burrows beneath the same chunk, but more often both they and the adults are solitary. The eggs are laid in June and July, and the newly hatched young are to be found in numbers during July and August.

134. *GRYLLUS ARENACEUS* sp. nov. The Sand-Loving Cricket.

Body very slender, of medium length. Head, black, but little, if any, wider than pronotum, the vertex prominent; the cheeks and palpi reddish brown. Pronotum black; its length contained in its width 1.43 times, the fore and hind margins truncate, very narrowly edged with reddish brown; the median impressed line visible only

on anterior half. Tegmina reddish brown, lighter along the humeral angle, covering a little more than half the abdomen in the female, three-fourths or more of abdomen in the male. Wings present but very narrow and shorter than the tegmina; abdomen shining black. All the legs reddish brown throughout, except the hind femora which sometimes have the apical half of outer and inner faces blackish. These femora are short and rather slender. Hind tibiae with six or seven rather long spines on their outer carina. Ovipositor nearly one and a half times longer than hind femora, the average ratio being 1.43:1, dark reddish brown in color.

Measurements: Length of body, male and female, 15 mm.; of pronotum, male, 3.2 mm., female, 3.5 mm.; of tegmina, male, 9 mm., female, 7 mm.; of hind femora, male, 10 mm., female, 11.5 mm.; of ovipositor, 16.5 mm. Width of pronotum, male, 4.7 mm., female, 5 mm.

This species has been taken only in the sand dune region of Lake County, Indiana, where it is rather plentiful in September and October beneath logs and chunks in bare sandy places. It is more slender bodied than any of our species except the house cricket, *G. domesticus*, which it resembles in form. The reddish brown color of tegmina, legs and cerci, contrasts strongly with the deep black of pronotum and abdomen. It will probably be found in sandy localities in the northern half of the State, especially in those counties bordering Lake Michigan.

135. *GRYLLUS ABBREVIATUS* Serville. The Common Field Cricket.

Gryllus abbreviatus Serv., 196, 1839, 336; Scudd., 141, VII, 1862, 427; Id., 188, 1900, 89; Id., 194, IX, 1902, 291; Glov., 62, 1872, Plate VII, Fig. 17; Sauss., 132, VI, 1874, 400, 518; Id., 133, II, 1877, 317; Pack., 104, 1883, 564; Riley, 122, II, 1884, 181; Fern., 53, 1888, 15; McNeill, 88, VI, 1891, 5; Bl., 5, 1892, 132 (in part); Id., 12, VII, 1895, 250; Id., 16, 1899, 226, Fig. 55; Beut., 3, VI, 1894, 265; Lugg., 84, 1898, 264, Fig. 172.

Acheta abbreviata Harr., 72, 1862, 152, Fig. 69; Rathv., 109, 1862, 380, Fig. 15.

Gryllus luctuosus Serv., 196, 1839, 335; Scudd., 141, VII, 1862, 427; Id., 148, 1874, 363; Id., 188, 1900, 89; Thomas, 205, 1872, 433, Plate I, Figs. 10, 11; Glov., 62, 1872, Plate IX, Fig. 10; Sauss., 132, VI, 1874, 396; Id., 133, II, 1877, 317; Pack, 104, 1883, 564; Fern., 53, 1888, 15; Comst., 41, 1888, 121.

Gryllus angustus Scudd., 141, VII, 1862, 427.

Body large and especially wide. Head of male shining black, much swollen, and broader than pronotum; of female less prominent. Pronotum black, broad, its length contained in its width nearly 1.5 times, the median impressed line rather faint; the hind margin truncate or

very slightly convex. Tegmina usually a very dark reddish brown or black; sometimes dull yellowish brown, covering three-fourths or more of abdomen in female and all of abdomen in male. Wings much shorter than tegmina in the common form (*abbreviatus*) or nearly as long again in the long winged form (*luctuosus*). Hind femora very stout, black or dark reddish brown, the basal third of the under and inner sides almost always brick red. Ovipositor very long, equaling or exceeding the body in length, and nearly or fully half as long again as the hind femora.

Measurements: Length of body, male, 18-20 mm., female, 18-22 mm.; of pronotum, male and female, 4.75 mm.; of tegmina, male and female, 12 mm.; of hind femora, male, 13 mm., female, 13.5 mm.; of ovipositor, 18-21 mm. Width of tegmina, male and female, 1 mm.

This is, in late summer and early autumn, the most common field cricket occurring in Indiana. In a former paper I stated that the young lived over winter, but more careful observation has proven that the young found in winter are those of *americanus* and *pennsylvanicus*. Professor McNeill, *loc. cit.*, has given an excellent account of the life history of this species as follows: "The eggs of *abbreviatus* hatch in this latitude (northern Illinois) in July, and the first adults appear as early as the second week in August. During every stage of life they are social, feeding together, seeking shelter in company and when egg laying time comes, in October, the females collect by hundreds in some suitable locality, an abandoned or little used roadway suits them well, and each lays several hundred eggs in an irregular mass. After this duty is performed their business on this planet seems to be finished and they succumb to the cold, none surviving the winter. The eggs do not hatch until the following July, or if in rare cases they do they probably perish with cold."

In southern Indiana the eggs hatch in late May or early June and the mature males appear about July 1st, but in the central and northern parts of the State the first males appear about a month later.

Gryllus abbreviatus is, in habits, nocturnal, omnivorous, and a cannibal. Avoiding the light of day, it ventures forth, as soon as darkness has fallen, in search of food, and all appears to be fish which comes to its net. Of fruit, vegetables, grass and carrion, it seems equally fond and does not hesitate to prey upon a weaker brother when opportunity offers. I have often surprised them feasting on the bodies of their companions, and of about 40 imprisoned together in a box, at the end of a week but six were living. The heads, wings and legs of their dead companions were all that remained to show that the weaker had succumbed to the stronger—that the fittest, and

in this case the fattest, had survived in the deadly struggle for existence.

The long winged form of *abbreviatus* is seemingly very scarce in this State, but one or two having been taken. There is little doubt but that Scudder is right in referring this form to Serville's *luctuosus* and placing it as a synonym of *abbreviatus*, as Serville states that the ovipositor of *luctuosus* is 9 to 10 lines in length, which is too great for *pennsylvanicus* of which McNeill thought *luctuosus* might be the long winged form. According to strict rules of nomenclature the name *luctuosus* rather than *abbreviatus* should belong to the insect since the former was described first in Serville's work. However, the short winged form seems to be everywhere the more common and better known, hence I follow Scudder in retaining the name *abbreviatus*. The range of the species covers the United States east of the Rocky Mountains.

136. *GRYLLUS PENNSYLVANICUS* Burmeister. The Pennsylvania Field Cricket.

Gryllus pennsylvanicus Burm., 40, II, 1838, 734; Scudd., 141, VII, 1862, 429; Id., 188, 1900, 90; Id., 193, IX, 1901, 268, 269; Id., 194, IX, 1902, 291; Glov., 62, 1872, Plate I, Figs. 13, 14; Sauss., 132, VI, 1874, 401; McNeill, 88, VI, 1891, 4, 6; Bl., 12, VII, 1895, 250; Bent., 3, VI, 1894, 265, Plate V, Figs. 6, 7; Lugg., 84, 1898, 264, Fig. 173.

Gryllus luctuosus McNeill, 88, VI, 1891, 4; Bl., 5, 1892, 133.

Acheta niger Harr., 72, 1862, 152.

Gryllus neglectus Scudd., 141, VII, 1862, 428; Id., 188, 1900, 89.

A medium sized but rather broad species; the head of male not so swollen as in *abbreviatus*, a little wider than the pronotum, shining black in color. Pronotum proportionally a little wider and shorter than in *abbreviatus*, the length contained in the breadth nearly 1.6 times, the hind margin a little sinuate, the median impressed line plainly visible on anterior half. The tegmina vary in color from a deep black to a smoky or grayish brown, rarely a dull reddish brown, often with a yellowish brown line along the humeral angle; the inner edges straight and overlapping or attingent their full length; those of female reaching nearly to tip of abdomen in short winged form, or slightly exceeding the tip in the long winged form; those of male reaching the tip of abdomen in both forms. Wings either narrow and shorter than tegmina or extending considerably beyond tegmina in the form of tail-like projections. Pronotum, legs, and under side of body in freshly matured specimens often with a minute grayish pubescence which becomes abraded with age, leaving these parts shining black. Hind femora short and stout, its average

length contained in that of ovipositor 1.1 times. Ovipositor always shorter than the body, its average length being 13.5 mm.

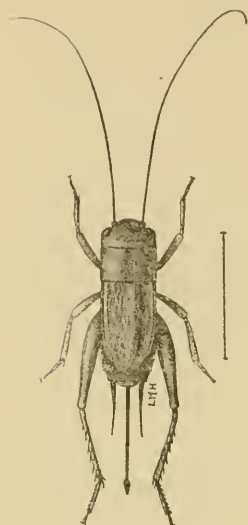


Fig. 110. *Gryllus pennsylvanicus* (Burm.) Short-winged female. (After Lugger.)

Measurements: Length of body, male, 17.5 mm., female, 17.1 mm.; of pronotum, male, 3.9 mm., female, 4.2 mm.; of tegmina, male, 11.5 mm., female, short winged form, 10 mm., long winged form, 12.4 mm.; of hind femora, male, 12.2 mm., female, 12.4 mm.; of ovipositor, 13.5 mm.; width of pronotum, male and female, 6.3 mm.

From *abbreviatus* this species may be distinguished by the shorter body, the less swollen head of male and especially by the short ovipositor, which in Indiana specimens ranges between 13 and 14 mm. in length. The main distinguishing characters between *pennsylvanicus* and *americanus* have been set out under the latter species. Another, very noticeable in the field in the spring, is the dull grayish tinge of *pennsylvanicus*, especially on the legs and pronotum, the whole body of *americanus* being shining black.

The description of *pennsylvanicus* by Burmeister is as follows: "Eine ähnliche Art (*Gr. pennsylvanicus*) findet sich in Nordamerika; sie ist etwas kleiner, die Flügeldecken kürzer als der Leib, ohne gelbe Basis, aber mit braunlicher Hauptlangader." This description is so short and vague that it is impossible to ascertain from it just what species he had at hand. Neither Saussure nor Scudder seem to have seen Burmeister's type. If so, they have made no record of the fact. Saussure in his latest paper, followed by McNeill, has asserted his belief that *pennsylvanicus* is a short winged form of *luctuosus*. However, the measurements of body and ovipositor of *luctuosus* as given by Serville agree so closely with those of *abbreviatus* that there can be no doubt of the two being the same. The existence of the long winged forms of both *abbreviatus* and the species I call *pennsylvanicus* has done much to add to the confusion. I have therefore followed Scudder, Beutenmüller and others in applying the name *pennsylvanicus* to the form at hand, though I have no definite means of knowing that it is the same insect as that to which Burmeister gave the name. Certain it is, however, that it is distinct from both *americanus* and *abbreviatus* described above.

In Indiana *pennsylvanicus*, for the most part, survives the winter in the nymph stage, the young, on the approach of cold weather, making for themselves cone-shaped cavities an inch or two across the top and about as deep, in the mold beneath decaying logs and rubbish. Sometimes the margins of these burrows are surrounded by fragments of grass stems and pieces of decaying leaves. In warm, sheltered localities, some individuals evidently reach maturity in late autumn or early winter; a full grown, freshly moulted female having been taken in a greenhouse in Marion County, on December 14th. The males begin to pass their final moult in central Indiana about May 15th, and from then on through June and July the open woods pastures and the angles of old rail fences echo with the music of their song. The young hatch in July and August, and after the second or third moult form their winter abiding places, while the adults perish with the coming of the hoar frost.

Pennsylvanicus occurs throughout the State and is said by Scudder to range across the continent. The long winged form is much less common than the short winged and is seldom met with in the field; but may often be found about electric and other lights during the summer nights. However, on two occasions in June, I have taken a long winged male in company with two short winged females beneath logs.

137. *GRYLLUS DOMESTICUS* Linnaeus. The House Cricket.

Gryllus (*Achetu*) *domesticus* L., 81, I, 1758, 428.

Gryllus domesticus Glov., 62, 1872, Plate VI, Fig. 14; Sauss., 132, VI, 1874, 400; Riley, 122, II, 1884, 181; Bent., 3, VI, 1894, 266, Plate V, Fig. 8; Marlatt, 85, 1896, 52, Fig. 20; Lugg., 84, 1898, 266, Fig. 176; Scudd., 188, 1900, 89; Id., 194, IX, 1902, 291, 294.

Pale yellowish brown or straw color; the head with a dark reddish brown bar on occiput just in front of pronotum; another between the upper portions of eyes; a third between the bases of the antennæ and a fourth across the labrum, the lower two sometimes united. Pronotum with four or five irregular shaped spots of reddish brown on its dorsal surface, and a narrow bar of the same color on each side; the posterior margin a little convex. Tegmina reaching nearly or quite to the end of abdomen; sometimes with a reddish brown spot on

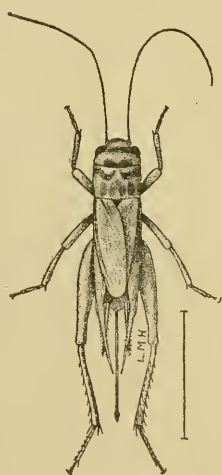


Fig. 111. *Gryllus domesticus* L. Female. (After Lugg.)

their basal third. Inner wings either short and covered by, or extending considerably beyond, the tegmina. Hind femora short and rather slender. Ovipositor one-fifth longer than hind femora, pale brown except the tip, which is darker.

Measurements: Length of body, male, 16.5 mm., female, 15 mm.; of pronotum, male and female, 3.5 mm.; of tegmina, male and female, 11 mm.; of hind femora, male and female, 10 mm.; of ovipositor, 12 mm. Width of pronotum, 4.5 mm.

The "house cricket," or "cricket of the hearth," is scarce in Indiana. Until January 1, 1903, I had in my collection but three specimens, two long winged males and a short winged female, taken by H. McIlroy from beneath rubbish in a gravel pit near West Terre Haute, Vigo County, in October, 1894. On the date mentioned I secured a dozen or more adults and nymphs in a greenhouse belonging to W. J. Hasselman, situated just north of the city of Indianapolis. The proprietor informs me that the males utter their call note throughout the winter, and that the insect is seemingly most abundant at that season. It is an Old World insect which has been introduced into this country, and occurs sparingly in most of the States east of the Rocky Mountains. Scudder states that he has seen no short winged specimens from the United States though they are common in Europe. The insect is probably less abundant in Indiana than it was a half century ago, when log houses and old fashioned brick and stone fireplaces were most in vogue. *Domesticus* has also been noted in Putnam County by J. S. Michaels. It is probable that in many instances the so-called "house crickets" of the present country homes are field crickets, especially *G. abbreviatus*, which have striven to prolong their existence by seeking shelter within the domiciles of man.

Marlatt, *loc. cit.*, has given the following pleasing account of the habits of this house cricket: "In Europe, and in some parts of the United States, no insect inhabitants of dwellings are better known than these domestic or house crickets, not so much from observation of the insects themselves as from familiarity with their vibrant, shrilling song notes. These notes, while thoroughly inharmonious in themselves, are, partly from the difficulty in locating the songster, often given a superstitious significance and taken, according to the mood of the listener, to be either a harbinger of good and indicative of cheerfulness and plenty, or to give rise to melancholy and to be-tokened misfortune. The former idea prevails, however, and Cowper expresses the common belief that the—

" 'Sounds inharmonious in themselves and harsh,
Yet heard in scenes where peace forever reigns,
And only there, please highly for their sake.'

"The house cricket usually occurs on the ground floor of dwellings and evinces its liking for warmth by often occurring in the vicinity of fireplaces, concealing itself between the bricks of chimneys or behind baseboards, frequently burrowing into the mortar of walls. It is particularly apt to abound in bakehouses. It is rarely very abundant but at times multiplies excessively and becomes a very serious nuisance. During cold weather or in cold rooms in winter, it remains torpid, but under the influence of warmth it becomes active and musical. It is easily kept in captivity as a pet, and will reward the possessor by furnishing an abundance of its peculiar melody, and in Spain it is often kept, it is reported, in cages, as we do singing birds. It is in the main nocturnal in its habits, coming out in the dusk of the evening and roaming about the house for whatever food materials it may discover. It feeds readily on bread crumbs or almost any food product to which it can get access, and is particularly attracted to liquids, in its eagerness to get at which it often meets death by drowning. It is a very pugnacious insect and will bite vigorously if captured, and is often predaceous or carnivorous, like most of its outdoor allies. It is supposed to feed on various other house insects, such as the cockroach and is also probably cannibalistic. A pair of native species kept in a cage by the writer, for a short period manifested the greatest friendliness, but the male shortly afterwards made a very substantial meal of his companion.

"These Crickets, in common with most other Orthoptera, will occasionally in pure wantonness seemingly, cut and injure fabrics, and are particularly apt to cut into wet clothing, evidently from their liking for moisture. Any of the common field grasshoppers or crickets, entering houses, are apt to try their sharp jaws on curtains, garments, etc., and Dr. J. A. Lintner records the case of a suit of clothing just from the tailor which was completely ruined in a night by common black field crickets (*Gryllus luctuosus*), which had entered an open window in some numbers. There is a popular superstition also to the effect that if a cricket be killed its relatives will promptly cut the garments of the offender.

"The house cricket may be readily destroyed by taking advantage of its liking for liquids, and any vessel containing beer or other liquid placed about will usually result in crickets being collected and drowned in numbers. It may also be destroyed by the distribution of uncooked vegetables, such as ground up carrots or potatoes, strongly poisoned with arsenic. In the use of poisoned baits in dwellings great care, however, should always be exercised."

LVII. *MIOGRYLLUS* Saussure (1877).

According to Scudder, this genus is distinguished from *Gryllus* by the much smaller size of its representatives, which approximate those of *Nemobius* in length; in the absence or extremely inconspicuous nature of the hearing organ on the inner side of the fore tibiae; in the unbranched or one-branched mediastinal nerve of the tegmina; in the strictly longitudinal course of the veins on the dorsal field of the female tegmina; in the shortness of the hind tibiae which are only two-thirds as long as the hind femora and armed on each side with only four or five spines, and in the striped or banded summit of the head.

Five species of the genus are known to occur in the United States. Of these, one has been found in southern Indiana.

138. *MIOGRYLLUS SAUSSUREI* (Scudder).

Gryllus saussurei Scudd., 160, XIX, 1877, 35; Id., 161, VI, 1878, 13; Id., 188, 1900, 90.

Miogrillus saussurei Scudd., 192, IX, 1901, 257.

Head rather large, shining black except a yellowish white line on each side of the eyes, extending back to the pronotum; that on the outer side double the width of the other; in most specimens two short whitish lines between these on the occiput. Palpi yellowish, the apical joint sometimes darker. Antennae dark brown, paler at base. Pronotum broader than long, slightly narrower behind than in front, the anterior border slightly concave, the posterior straight; blackish, faintly mottled with yellowish brown, the front margin sometimes faintly edged with the same; the lower half of the deflected lobes pale yellow edged very narrowly below with black, the upper half of the lobes darker than the upper surface and uniform; front and hind margins with a few curved black bristles. Tegmina of the female but little longer than the pronotum, covering about one-third of the abdomen; those of the male covering two-thirds of the abdomen; reddish brown or blackish in color, the humeral angle black; the longitudinal veins and marginal area often paler. Wings almost wanting. Legs either yellowish brown or blackish. Hearing organ on the fore tibiae fully one-third the length of the tibiae on its outer face; wanting on its



Fig. 112. *Miogrillus saussurei* (Scudd.) Female. One and one-third times natural size. (Original.)

lowish brown or blackish. Hearing organ on the fore tibiae fully one-third the length of the tibiae on its outer face; wanting on its

inner face. Abdomen black, with a lighter brown lengthwise band on each side of its dorsal surface. Ovipositor equaling the hind femora in length, yellowish brown in color, the apex darker.

Measurements: Length of body, male, 11.5 mm., female, 14 mm.; of pronotum, male and female, 3 mm.; of tegmina, male, 4.5 mm., female, 3.5 mm.; of hind femora, male and female, 9.5 mm.; of hind tibiæ, male and female, 6 mm.; of ovipositor, 9.5 mm.

This species, resembling in general appearance a large *Nemobius*, has been taken only in Knox, Gibson and Crawford counties, where it occurs on dry wooded hillsides beneath flat stones and logs. It seems to like best places devoid of grass and other vegetation. In southern Indiana it probably reaches maturity about the middle of June, as it seems to be most abundant by the last of that month. Quite a number of specimens were taken in the vicinity of Wyandotte Cave in 1902. It is a southern species which has heretofore been recorded only from Georgia and Florida, and it will therefore probably be found only in the southern third of Indiana.

Sub-family ŒCANTHINÆ.

This sub-family comprises the slender bodied ivory or greenish white tree crickets. Our Indiana species have the pronotum elongated and narrow, its sides deflexed, the posterior margin somewhat broader than the anterior. The wing covers of the male are flattened, semi-transparent, rather firm in texture and much broader than the body. Those of the female are wrapped close about the body, causing such a difference of appearance between the two sexes that collectors often take them for widely different species. The hind femora are weak and slender. The tibiæ, in our most common species, are armed with delicate spines between which are minute teeth, visible only under a lens. The tarsi are four-jointed, elongated and compressed, the second joint being very small and compressed. The ovipositor is straight and shorter than the hind femora; its apex a little enlarged and rather blunt.

All our species are strictly arboreal, living mainly on vines, shrubbery and the taller herbaceous plants. They especially frequent the various species of golden-rod and wild sunflowers, and often three or four can be found on a single one of these plants. For the most part they remain quiescent during the day, but are quite active at night.

Scudder recognizes but one genus, *Œcanthus*, as belonging to our fauna. One species, however, has no spines on the hind tibiæ, and since the presence or absence of these spines is deemed of sufficient importance to be used as one of the principal characters in separat-

ing the sub-families, it is surely of generic value. I therefore separate our species into two genera, which may be distinguished as follows:

KEY TO GENERA OF INDIANA CECANTHINÆ.

- a.* Hind tibiæ armed with weak spines, and small teeth between the spines; first joint of antennæ smooth; inner wings but little, if any longer than the tegmina.....LVIII. CECANTHUS, p. 444
- aa.* Hind tibiæ unarmed; first joint of the antennæ armed with a stout, blunt tooth in front; inner wings nearly twice as long as the tegminaLIX. XABEA, p. 453

LVIII. CECANTHUS Serville (1831).

The main characters of this genus have been given under the sub-family heading and in the above key. The tegmina of the female are regularly reticulated, with the oblique longitudinal veins plainly visible. The mediastinal vein of the male tegmina is not strongly bowed, and the humeral angle is distinct. The tarsi are imperfectly four-jointed, the division between the third and fourth joints being visible, but the fourth joint is seldom movable by itself. The name CECANTHUS, signifying "I dwell in the flowers," is not always true as the insects are as often found upon the foliage of plants as in the flowers proper. Five species occur in Indiana and may be separated by the following table:

KEY TO INDIANA SPECIES OF CECANTHUS.

- a.* Antennæ without black marks on the under side of the first two joints; tegmina of male more than half as broad as long; front of head and basal joints of antennæ usually pinkish.....
139 *latipennis*, p. 445
- aa.* Antennæ with one or more black marks or spots on the under side of the first two joints; tegmina of male less than half as broad as long; front of head and basal antennal joints never pinkish.
 - b.* Antennæ with but one black mark on each of the two basal joints.
 - c.* Black marks on antennæ in the form of small rounded dots140 *niveus*, p. 446
 - cc.* Mark on first joint of antennæ, long and hooked at base, that on the second joint oblong; wing covers of male narrower and tibial spines weaker than in *niveus*.....
141 *angustipennis*, p. 450
 - bb.* Antennæ either wholly black or with two black marks on each of the two basal joints.
 - d.* Head and thorax, either black or trifasciate with black; antennæ usually black; when pale, the marks on first joint generally connected at apex.....
142 *fasciatus*, p. 450

dd. Wholly pale greenish or yellowish, translucent; marks on antennæ elongate, parallel, distinct.

143 *quadripunctatus*, p. 452

139. *ECANTHUS LATIPENNIS* Riley. The Broad-winged Tree Cricket.

Ecanthus latipennis Riley, 121, 1881, 61; *Id.*, 122, II, 1884, 182; Brun., 23, 1888, 120, Fig. 39; *Id.*, 32, 1895, 69, 113, Fig. 40; McNeill, 88, VI, 1891, 6; Hart, 73, III, 1892, 33, Fig. 6; Beut., 3, VI, 1894, 272; Lugg., 84, 1898, 273, Fig. 184; Scudd., 188, 1900, 90.

Size, large. Color of male greenish white; of female, pale yellowish green. Antennæ with basal joints destitute of black markings; these joints and top of head usually roseate or pinkish. Tip of ovipositor dark. Tegmina of male, when unfolded, four-fifths as wide as long, much wider than in any other species. Inner wings of male shorter than tegmina; those of female equaling or slightly exceeding the tegmina.

Measurements: Length of body, male and female, 12.5 mm.; of pronotum, male and female, 3.1 mm.; of tegmina, male, 15 mm., female, 14.5 mm.; of inner wings, male, 12 mm., female, 15 mm.; of hind femora, male and female, 10 mm.; of ovipositor, 6.5 mm. Width of dorsal surface of tegmina of male, 7.5 mm.

This species has been taken only in Vigo and Putnam counties, but probably occurs in all parts of the State, as its range covers the United States east of the Great Plains. It lives mainly on shrubs and vines along the borders of thickets and fence rows, and with us is most abundant from August 10th to October 1st.

The eggs of the broad-winged tree cricket are laid in the pith of the smaller twigs of shrubs and vines, preferably in the slender twigs of the wild and cultivated grapes. Dr. Riley has described the method of oviposition as follows: "The jaws are first used to slightly tear the outer bark. With the antennæ stretched straight forward and the abdomen bent up so as to bring the ovipositor at right angles with the cane, the female then commences drilling, working the abdomen convulsively up and down about twice each second. The eggs are laid lengthwise in the pith, but always in two sets, one on each side of the hole. The number varies according to the size of the cane, and the distance between the holes is also variable. The hole is usually filled up with a white mucous secretion, though there is very little of it about the eggs. This secretion also doubtless serves to facilitate the drilling. The same female will lay over 200 eggs, and will sometimes puncture the same cane at intervals of one-third of an inch for one and a half feet or more."



Fig. 113. Four basal joints of antennæ of *Ecanthus latipennis* Riley. (After Lugg).

The day note of the male of *latipennis* is louder than that of any other species. I have heard it when 60 feet distant; have traced it up, and found the musician beneath a leaf or on a post in the angle of a rail fence, industriously sounding his cymbals. The note is kept up for 20 to 30 seconds, and is then succeeded by a pause of about five seconds, when it is begun once more. Dr. Riley has written of it, probably of the night song: "The shrill of *latipennis* is continuous and recalls the trilling of a high-pitched dog-whistle in the distance. The key varies, however, and is sometimes much less high and more musical than at others. The commingled shrill of this species recalls also the distant croaking of frogs in spring. The broad wings are thoroughly elevated during the act, or even bent forward, and the vibration is so rapid that there appears to be no motion."

140. (*ECANTHUS NIVEUS* (De Geer). The Snowy Tree Cricket.

Gryllus niveus De G., 57, III, 1773, 522, Plate 43, Fig. 6.

Ecantus niveus Fitch., 56, XVI, 1856, 404; Harr., 72, 1862, 154, Figs. 71, 72; Scudd., 141, VII, 1862, 431; Id., 148, 1874, 365 (note of set to music); Id., 168, XXIII, 1893, Figs. 65, 66; Id., 188, 1900, 91; Rathv., 109, 1862, 381, Figs. 17, 18; Walsh., 220, I, 1866, 126; Id., 221, II, 1867, 54, 94; Riley, 113, I, 1869, 138, Figs. 77, 78; Id., 114, V, 1873, 120, Fig. 49; Id., 121, VI, 1881, 60; Id., 122, II, 1884, 182, Figs. 256, 257; Glov., 62, 1872, Plate IV, Figs. 1, 2; Id., 63, 1874, 143, Fig. 16; Pack., 104, 1883, 564, Figs. 561, 562; Id., 107, V, 1890, 230, 591, Figs. 75, 76; Fern., 53, 1888, 17, Figs. 7, 8, 9; Comst., 41, I, 1888, 122, Figs. 109, 110; Murtf., 103, II, 1889, 130; McNeill, 88, VI, 1891, 6; Bl., 5, 1892, 141; Id., 16, 1899, 229, Figs. 57, 58; Hart, 73, III, 1892, 33, Fig. 4; Bent., 3, VI, 1894, 269, Plate V, Figs. 12, 13; Brun., 32, 1895, 110, Figs. 37-39; Id., 35, 1899, 133, Figs. 48, 49; Lugg., 84, 1898, 269, Figs. 177, 178.

Both sexes of this species are in color ivory white, more or less tinged with a delicate green, especially in the female. The top of head and basal joint of antennæ are sometimes suffused with ochre yellow, while on the lower face of each of the two basal joints of the antennæ is a small round black spot. The tegmina are almost twice as long as the abdomen and the inner wings equal or slightly exceed them in length. The ovipositor of the female is short, perfectly straight and usually tipped with black. The maxillary palpi are longer in this



Fig. 114. Basal joints of antennæ of *Ecantus niveus* (DeG.)

than in any other species of the genus, and the wing covers of the male are broader in proportion to their length than in any other except *O. latipennis*, when unfolded being two-thirds as wide as long.

Measurements: Male—Length of body, 12 mm.; of wing covers, 12.5 mm.; of hind femora, 8.7 mm.; width of wing covers, 5.5 mm. Female—Length of body, 14.5 mm.; of wing covers, 14 mm.; of hind femora, 10 mm.; of ovipositor, 5.5 mm.



Fig. 115. *Ecanthus niveus* (DeG.) Male and female. (After Beutenmüller).

While the snowy tree cricket occurs in all parts of Indiana, it appears to be less common in the State than either *O. fasciatus* or *O. quadripunctatus*, and much of the published literature relating to it has doubtless been of these two species, especially the latter. Like the other members of its genus *niveus* reaches maturity in southern Indiana about July 1st, and in the central part a fortnight later, and exists in that stage until after heavy frosts. In the writer's experience, the females are more plentiful than the males, the latter being more often heard than seen. During the day they keep themselves hidden among the foliage and flowers of various plants, but as night approaches they come forth and the male begins his incessant, shrill, chirping note, which he continues with little or no intermission till the approach of morning warns him to desist. Professor McNeill, *loc. cit.*, has given an excellent description of the songs of the different species of *Ecanthus*. "That of *niveus*," he says, "is the well-known *t-r-r-r-e-e*, *t-r-r-r-e-e*, repeated without pause or variation about seventy times in a minute. It is heard only at night and occasionally on cloudy days, but in the latter case it is only an isolated song, and never the full chorus of the night song produced by many wings whose vibrations in exact unison produces that characteristic 'rhythmic beat,' as Burroughs has happily phrased it."

Fitch, writing of the note of the same insect in New York, has said: "In the southern part of our State the song of the snowy tree cricket begins to be heard as early as the first of August. Perched among the thick foliage of a grapevine or other shrubbery, some feet up from the ground, and remaining in the same spot day after day, its song begins soon after sunset and before the duskiess of twilight arrives. It is distinctly heard at a distance of several rods, and the songster is always farther off than is supposed. Though dozens of other crickets and katydids are shrilling on every side at the same time, the peculiar note of this cricket is at once distinguished from all the rest, consisting of repetitions of a single syllable, slowly ut-

tered, in a monotonous, melancholy tone, with a slight pause between. The children regard the cricket as no votary of the temperance cause; they understand its song to consist of the words *treat*, —*treat—treat—treat*, which words, slowly uttered, do so closely resemble its notes that they will at once recall them to the recollection of almost every reader. And the song is thus continued without the slightest variation and without any cessation, I think, the whole night through. I, however, have sometimes heard it at the first commencement of its evening serenade uttering three syllables resembling the words *treat, treat, two; treat, treat, two*—as though the songster was supplicating a libation for his voiceless mate as well as himself—a longer pause following each third note. This prelude is probably performed in limbering or otherwise adjusting his organs, preparatory to performing the regular carol, which is struck into in a few moments.”

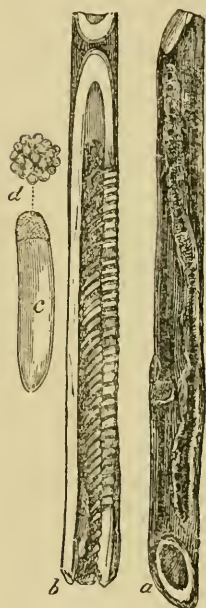


Fig. 116. Eggs of Tree Cricket in raspberry cane.

- (a) Cane, showing puncture.
 - (b) Cane split to show eggs.
 - (c) Egg enlarged.
 - (d) Cap of egg enlarged.
- (After Riley.)

The females do much harm by ovipositing in the tender canes or shoots of various cultivated fruits, as the raspberry, blackberry, grape, plum, peach, etc.; no less than 321 eggs, by actual count, having been found in a raspberry cane 22 inches in length. So partial is it to the stems of raspberry and blackberry as receptacles for its eggs that in some localities scarcely a cane escapes without being more or less damaged. The eggs are laid in autumn, and at first the injury is shown only by a slight roughness of the bark, but afterwards the cane or branch frequently dies above the puncture, or is so much injured as to be broken off by the first high wind. If the injured and broken canes containing the eggs be collected and burned in early spring the number of insects for that season will be materially lessened.

Professor Bruner, *loc. cit.*, has written of its habits of oviposition in other plants as follows: “In addition to cultivated fruits the snowy tree cricket also deposits its eggs in the stems of a large variety of other plants and trees—the main requirements being a soft fibre and pithy interior to the twigs selected. Among the trees the white willow suffers most. I have seen hedges of this tree so com-

pletely utilized that scarcely a twig escaped being deposited into. Other species of willow, cottonwood, elm, maple, box elder, cherry, dog-wood, black locust, sycamore, ash, honey-locust, and in fact almost all kinds of trees, are sometimes attacked. Elder is a great favorite, too. After these come weeds, as the artichoke, sunflower, golden-rod, ambrosia, and many others. All of these latter being annuals, or dying to the ground each year, whether attacked by the cricket or not, the conclusion is plain. All the cricket requires is a receptacle for her eggs. It matters but little whether a dead or a living plant furnishes that condition.

"In the case of the honey locust, the thorns as a rule receive the eggs instead of the twigs, and no apparent damage is done. The mature crickets are also said to be met with abundantly upon oaks, hickories, and elms during the egg-laying season, and evidently use these also occasionally for the deposition of their eggs, although I have never obtained or noticed the eggs in the twigs of these trees.

"While woody plants are known to be very commonly used as receptacles for the eggs of this cricket, it is by far the most numerous upon such weeds as those mentioned above during its entire career; but more particularly so during its latter days when looking after the perpetuation of its kind."

Niveus, however, in part, if not wholly, offsets its injurious habit by its carnivorous propensities, as the young which hatch in May or early June, feed, until they reach maturity, upon the various species of aphids or plant lice which infest the shrubbery they frequent. Mr. B. D. Walsh, *loc. cit.*, was the first entomologist to call attention to this carnivorous habit, but it seems little attention was given to the matter. Recently, however, it has again attracted notice, and in *Insect Life* for November, 1891, Miss Mary E. Murtfeldt, of St. Louis, Missouri, gave an interesting account of some experiments and observations concerning this habit from which the following extract is taken: "Some leaves of plum infested with a delicate species of yellow aphid were put into a jar with the young of *Æcanthus niveus*, but attracted no immediate attention. As twilight deepened, however, the crickets awakened to greater activity. By holding the jar against the light of the window, or bringing it suddenly into the lamplight, the little nocturnal hunters might be seen hurrying with a furtive, darting movement, over the leaves and stems, the head bent down, the antennæ stretched forward, and every sense apparently on the alert. Then the aphids provided for their food would be caught up one after another with eagerness and devoured with violent action of the mouth parts, the antennæ meanwhile play-

ing up and down in evident expression of satisfaction. Unless I had provided very liberally not an aphid would be found in the jar the next morning and the sluggish crickets would have every appearance of plethora."

141. *ECANTHUS ANGUSTIPENNIS* Fitch. The Narrow-winged Tree Cricket.
Ecantus angustipennis Fitch, 56, XVI, 1856, 404; McNeill, 88, VI, 1891, 8; Bl., 5, 1892, 143 (in part); Hart, 73, III, 1892, 33, Fig. 5; Scudd., 168, XXIII, 1893, 67; Id., 188, 1900, 90; Bent., 3, VI, 1894, 251, 270, Fig. 3; Brun., 32, 1895, 113; Lugg., 84, 1898, 271, Fig., 179.

Pale greenish white, each of the first two basal joints of the antennae with a black mark, that on the first joint being elongate and hooked inwards at the base; the mark on second joint oblong, slightly curved. Head smaller and pronotum narrower anteriorly than in *niveus*. Tegmina narrower than in any other species except *quadripunctatus*. Inner wings slightly surpassing the tegmina in length.



Fig. 117. Basal joints of antennae of *Ecantus angustipennis* Fitch.

Measurements: Length of body, male, 12 mm., female, 11.5 mm.; of pronotum, male and female, 2.75 mm.; of tegmina, male and female, 12 mm.; of inner wings, male and female, 13.5 mm.; of hind femora, male and female, 8.5 mm.; of ovipositor, 5.5 mm.

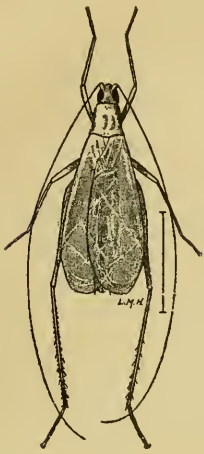
The narrow winged tree cricket is not a common insect in Indiana, having so far been taken only in Vigo, Putnam and Crawford counties. It frequents the borders of groves and especially ironweeds in open woods pastures and reaches maturity about July 15th. Scudder gives its range as "New York to Kentucky and Nebraska."

The note of *angustipennis* is fainter than that of *niveus* and may be represented by *reccccé*, lasting about five seconds, and terminating abruptly, with an equal interval of rest. It usually sings at night only, but sometimes also late in the afternoon in shady places, and on cloudy days.

142. *ECANTHUS FASCIATUS* Fitch. The Striped Tree Cricket.
Ecantus fasciatus Fitch, 56, XVI, 1856, 414; McNeill, 88, VI, 1891, 6; Bl., 5, 1892, 143; Hart, 73, III, 1892, 33, Fig. 1; Scudd., 168, XXIII, 1893, 66; Id. 188, 1900, 90; Brun., 32, 1895, 69, 113; Lugg., 84, 1898, 271, Figs., 180-182.
Ecantus nigricornis Walk., 219, I, 1869, 93; Sauss., 132, VI, 1874, 461; Bent., 3, VI, 1894, 250, 270, Fig. 4; Scudd., 188, 1900, 90.

Greenish yellow: the head and pronotum either wholly black or with three more or less distinct lengthwise black bars. Legs yellow-

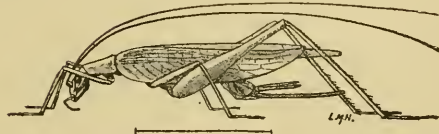
ish with a blackish tinge or wholly black. Body black beneath, yellowish green above. Antennae longer than in other species, often two



Male.



Fig. 119. Basal joints of antennae of *Ecanthus fasciatus* Fitch.



Female.

Fig. 118. *Ecanthus fasciatus* Fitch. (After Lugger).

and a half times the length of body, either wholly black or with two black marks on each of the two basal joints; the innermost mark on the first joint twice the length of the other, the two often united at the upper ends. Tegmina slightly narrower than those of *niveus*. Inner wings equaling or extending a little beyond the tegmina. Spines at apex of posterior tibiae stronger and more acute than in allied species. Ovipositor with its apical third slightly but distinctly upcurved.

Measurements: Length of body, male, 12.5 mm., female, 12 mm.; of pronotum, male and female, 3 mm.; of tegmina, male and female, 12 mm.; of inner wings, male and female, 13.2.; of hind femora, male, 10 mm., female, 9.2 mm.; of ovipositor, 5.7 mm. Width of tegmina, male, 5 mm.

The striped tree cricket is the most common member of its kind in Indiana. In August and September, nearly every stalk of golden-rod and wild sunflower along roadsides, in open fields or in fence corners, will have from one to a half dozen of these insects upon its flowers or branches. It is also especially abundant upon the tall weeds and bushes along the borders of lakes and ponds, and in sloughs and damp ravines.

The note of *fasciatus* is a shrill continuous *whi-r-r-r-r* which is kept up for several minutes with the intervals of irregular length.

It is continued for most of the night and on cloudy days. When the sun is shining brightly it usually begins about mid-afternoon and continues with but little pause until the dawn of the next day, unless the caller is, in the meantime, successful in wooing with his music one of the opposite sex within reaching distance.

On September 18, 1898, I was in late afternoon in a wet prairie near Hammond, Indiana, where *O. fasciatus* was more than usually abundant on clumps of wild sunflower. A half dozen or more pairs were seen in copulation. In this act it seems that the female mounts the body of the male, the latter first raising the tegmina until they stand at an angle of about 45 degrees, so as to give the female access to a pair of glands which lie immediately beneath the base of wings. The female worked at these glands with her mandibles, the male meantime moving the inner wings gently sideways, in and out. After working over the glands for ten or fifteen minutes, the female would usually leave the body of the male and crawl onto an adjacent head of the sunflowers. The male meantime kept the tegmina raised, seemingly in waiting for her return, which was always at the end of five or six minutes. During the process, no intromittent organ of the male was noticeable, nor was any union of the parts at the end of the abdomen seen. Is it possible that in the mating of these *Ecanthids* the female removes the semen from the glands whose openings are beneath the tegmina of the male, and then fertilizes her ova?

143. *ECANTHUS QUADRIPUNCTATUS* Beutenmüller. The Four-spotted Tree Cricket.

Ecanthus quadripunctatus Bent., 2, VI, 1994, 250; Id., 3, 271, Fig. 5; Scudd., 188, 1900, 91.

Ecanthus fasciatus Hart., 73, III, 1892, 33 (text in part), Fig. 2; Lugg., 84, 1898, 272, Fig. 183 (text in part).

Males, greenish white, females yellowish green, in color. Antennæ light brown, the basal joints pale green with two black marks on each; those on the second joint oblong, parallel, the inner about double the length of the outer; the inner mark on lower or basal joint, two-thirds the length of the joint, its upper end curved outward, but not united with the outer mark, which is short and almost round. Wing covers a little narrower than in *fasciatus*, the inner wings protruding slightly beyond their tips.

Measurements: Length of body, male and female, 11.5 mm.; of pronotum, 2.6 mm.; of tegmina, male, 12 mm., female, 10.5 mm.; of inner wings, male, 13.5 mm., female, 12.5 mm.; of hind femora, male

and female, 8.2 mm.; of ovipositor, 5.5 mm. Width of tegmina, male, 4.7 mm.

This is, next to *fasciatus*, the most common *Ecanthus* in central and southern Indiana. Specimens are before me from Vigo, Putnam, Marion, Floyd, Crawford and Posey counties. It frequents shrubbery and weeds in fence rows and gardens, and along roadsides; and while often found in company with *fasciatus*, has never been seen mating with that species. A female was taken in Crawford County on June 28th, an early date for a mature tree cricket. Scudder gives its range as "New York to Indiana." I have specimens from Agricultural College, Mississippi, and from Sherborn, Massachusetts, and have also found it abundant on the north shore of the Niagara River, opposite Buffalo, New York, where it was the only species present on September 4th.



Fig. 120. Basal joints of antennæ of *Ecanthus quadripunctatus* Beut.

LIX. XABEA Walker (1869).

The members of this genus may be known from those of *Ecanthus* by the following characters: The first joint of antennæ is armed on its under side with a stout blunt tooth. The tegmina of female are irregularly reticulated, the oblique longitudinal veins not being conspicuous; male tegmina with the mediastinal vein strongly arcuated; the humeral angle wanting. Inner wings nearly twice as long as the tegmina. Hind tibiæ with neither spines nor serrations, armed with only four apical spurs, two within and two without. First joint of posterior tarsi unarmed, the tarsi clearly but three-jointed, the second joint very short.

But one species of *Xabea* is known from the United States, occurring over most of the region east of the Great Plains.

144. XABEA BIPUNCTATA (De Geer). The Two-Spotted Tree Cricket.

Gryllus bipunctatus De G., 57, 1773, 523, Plate 43, Fig. 7; Burm., 40, II, 1838, 732.

Ecanthus bipunctatus Serv., 197, XXII, 1831, 135; Glov., 62, 1872, Plate IV, Figs. 5, 6; Sauss., 132, VI, 1874, 458, 462; McNeill, 88, VI, 1891, 9; Hart, 73, III, 1892, 33, Fig. 3; Scudd., 188, 1900, 90.

Xabea bipunctata Riley, 121, VI, 1881, 61; Beut., 3, VI, 1894, 272, Plate V, Fig. 14.

Ecanthus punctulatus Fitch, 56, XVI, 1856, 415.

Pale pinkish brown, the tegmina of female with two rather large blackish spots, one near the base, the other at the center. Basal joints of antennæ without black marks, but with the scape of the

first joint prolonged beneath, forming an acute blackish tooth. Inner wings much produced beyond the tegmina. Legs pale with a pinkish hue.

Measurements: Length of body, male and female, 13 mm.; of pronotum, 3.3 mm.; of tegmina, 11 mm.; of inner wings, 20 mm.; of hind femora, 9 mm.; of ovipositor, 6 mm.

This tree cricket is readily recognized by its unarmed hind tibiae, pinkish brown color, long inner wings and dark spots on female tegmina. It is scarce in Indiana, having as yet been taken only in Vigo County, though it will doubtless be found to occur throughout the State. So far as known, its habits are the same as those of the more common species of *Ecanthus*.

Sub-family TRIGONIDIINÆ.

The Indiana members of this sub-family are among the smallest of our native Gryllidæ. They are distinguished mainly by the different character of the second tarsal joint, which is depressed and heart-shaped, instead of compressed, as in the preceding sub-families. The tympanum or shrilling organ of the male is more simple than in other species, being divided by a single oblique vein. The hind tibiae have no serrations between the spines and bear but two apical spurs on the inner side. The ovipositor resembles that of some of the *Locus-tidæ* in being short, compressed and saber-like.

Three genera represent the sub-family in the United States. Of these two occur in Indiana.

KEY TO GENERA OF INDIANA TRIGONIDIINÆ.

- a.* Last joint of maxillary palpus club shaped; basal joint of antennæ sub-depressed, rather large.....LX. ANAXIPHA, p. 454
- aa.* Last joint of maxillary palpus very broad, spoon-like; basal joint of antennæ narrow, minuteLXI. PHYLLOSCIRTUS, p. 456

LX. ANAXIPHA Saussure (1874).

The members of this genus resemble those of *Nemobius* in form of body, breadth of head, etc., but the females are readily distinguished by the compressed and strongly upcurved ovipositor. The antennæ are very long and setaceous, the first joint being rather large and a little flattened. Ocelli present, but small and arranged in a triangle. Maxillary palpi rather long; the last joint dilated in the form of a funnel. Tegmina of male almost encasing the abdomen, the speculum or round glassy spot on their apical half prominent and undi-

vided by a cross nerve; inner wings absent. Hind tibiae armed with three pairs of slender spines, of equal length. One species occurs in the United States, ranging from New York to Texas.

145. *ANAXIPHA EXIGUA* (Say).

Acheta exigua Say, 138, IV, 1825, 309; Id., 139, II, 1859, 238.

Nemobius exiguus Sauss., 132, VI, 1874, 391.

Anaxipha exigua Scudd., 162, XIX, 1877, 82; Id., 168, XXIII, 1893, 67; Id., 188, 1900, 91; Bent., 3, VI, 1894, 268.

Gryllus pulicarius Burm., 40, II, 1838, 732.

Anaxipha pulicaria Sauss., 132, VI, 1874, 371, Plate 7, Fig. 1; Id., 133, II, 1878, 615.

Anaxiphus pulicarius Bl., 5, 1892, 137; Lugg., 84, 1898, 274, Fig. 185.

Head and pronotum dark reddish brown, sparsely covered with long hairs. Tegmina and legs light brown, the former reaching the end of the abdomen in the male, shorter in the female. Abdomen of male blackish; of female pale brown, darker on the sides. Ovipositor dark brown, paler at tip. Cerci very long and slender, clothed with long yellow hairs.

Measurements: Length of body, male, 6 mm., female, 7 mm.; of antennæ, male, 32 mm.; of tegmina, male, 4.5 mm., of female, 3.5 mm.; of hind femora, male and female, 6 mm.; of ovipositor, 3.5 mm.

This handsome little cricket has been taken in Vigo, Putnam, Fulton and Kosciusko counties. At Kewanna and De Long, Fulton County, it occurs in small numbers among the sphagnum mosses growing in dense tamarack swamps. In Vigo County it occurs about the borders of a large pond, and in Kosciusko County in a marsh bordering Tippecanoe Lake. In both these localities it was abundant on the leaves and stems of the arrow alum, cat-tail flags, button-bush and other semi-aquatic plants. It is very active and difficult to capture, and, on account of its small size, is doubtless overlooked in many localities where it occurs in abundance. In central Indiana it reaches maturity about August 1st, and exists until after heavy frosts. Unlike the *Nemobids*, which it most closely resembles, it is never found on the ground, but clings to the stems of bushes and grasses a few feet above the surface.



Fig. 121. *Anaxipha exigua* (Say). Female. Much enlarged. (After Lugg).

LXI. PHYLLOSCIRTUS Guérin (1840).

In this genus the head is noticeably wider than the pronotum, the eyes prominent and protruding; the ocelli indistinct or wanting. The basal joints of antennæ are rather small and narrow, and are proportionally farther apart than in most crickets. The apical joint of the maxillary palpus is dilated and spoon-shaped and much longer than the preceding joint, which is triangular. Pronotum sub-cylindrical, narrower in front. Tegmina as long or longer than the body, rather leather-like in texture. Inner wings nearly as long as the tegmina. Ovipositor short, compressed, curved strongly upward.

The genus is exclusively American. But one species is known in the United States, occurring only east of the Mississippi and south of the latitude of central Indiana.

146. PHYLLOSCIRTUS PULCHELLUS (Uhler). The Handsome Tree Cricket.
Phyllopalpus pulchellus Uhl., 212, II, 1864, 544; Glov., 62, 1872, Plate VI, Fig. 22.
Phylloscirtus pulchellus Sauss., 132, VI, 1874, 368; Id., 133, II, 1878, 637; Riley, 122, II, 1884, 183; Bl., 5, 1892, 137; Bent., 3, VI, 1894, 268, Plate V, Fig. 16; Scudd., 188, 1900, 91.

Head and pronotum bright crimson red, punctured; antennæ twice the length of the body, blackish at base and at tip, the middle portion yellowish; palpi black. Abdomen shining black; tegmina chestnut brown, the sides darker, with paler nervures. Cerci and legs pale yellow. Ovipositor brown, paler at base.

Measurements: Length of body, female, 7.5 mm.; of tegmina, 5 mm.; of hind femora, 5.5 mm.; of ovipositor, 3.5 mm.

But three specimens, all females, of this little bright colored cricket are in my collection from Indiana. One of these was taken on September 6th, from a leaf of the button-bush, *Cephalanthus occidentalis* L., near the border of a large pond in Vigo County. When discovered it was motionless, but was vibrating its large maxillary palpi in a very rapid and curious manner. A second specimen was taken by Mr. Hans Duden from the roadside near Edwardsville, Floyd County, on August 16th. It attempted to bite when picked up. The third was taken from the border of a marsh near Grand Chain, Posey County, on September 17th. It probably occurs in low wet woods throughout the southern half of the State. According to Uhler it is found in Maryland most frequently "amongst the grass and low bushes near ditches where it jumps about with great rapidity."

Sub-family ENEOPTERINÆ.

Medium sized *Gryllidæ*, having the second tarsal joint flattened and bi-lobed, as in the preceding sub-family. The hind tibiæ, however, have serrations between the spines and bear three apical spurs on each side. The tegmina of male in our genera are provided with a sounding organ or tympanum, and the ovipositor is cylindrical and straight or but little curved. Four genera occur in the United States, two of which are represented in Indiana.

KEY TO INDIANA GENERA OF ENEOPTERINÆ.

- a. Body short and broad; fore tibiæ with hearing organ on the inner face only; apical segment of the maxillary palpus nearly as long as the two preceding taken together; tegmina in both sexes not reaching the tip of abdomen.....LXII. APITHES, p. 457
- aa. Body rather long and slender; fore tibiæ with hearing organ on both faces; apical segment of maxillary palpus but little longer than the one preceding; tegmina extending much beyond the abdomen in both sexesLXIII. OROCHARIS, p. 459

LXII. APITHES Uhler (1864).

The main distinguishing characters of this genus have been given in the above key. In addition it may be stated that the head is almost globular and narrower than the pronotum; ocelli present; antennæ about three times the length of the body, their basal joints much thickened and cylindrical. Maxillary palpi with the last segment enlarged at tip; obliquely truncated. Pronotum short, narrower in front than behind, the lateral angles rounded, the anterior and posterior margins truncate. Tegmina with the humeral vein prominent, forming a carina along the humeral angle. Inner wings very short. Hind femora quite broad, though but little thickened. Hind tibiæ armed with two rows of spines which are curved at the tip, eight on the inner and five or six on the outer side.

Two species are known from the eastern United States, one of which occurs in Indiana.

147. APITHES AGITATOR Uhler.

Hapithus agitator Uhl., 212, II, 1864, 546; Glov., 62, 1874, Plate XVI,

Fig. 16; Riley, 122, II, 1884, 183, Fig. 23.

Apithis agitatrix Sauss., 132, VI, 1874, 490.

Apithes agitator Bl., 5, 1892, 139; Id., 16, 1899, 227; Scudd., 188, 1900, 91.

Hapithus quadratus Scudd., 144, XII, 1868, 140; Id., 164, 1879, 4.

Apithis quadrata Sauss., 132, VI, 1874, 488.

A short, heavy bodied cricket; dull reddish brown in color. Tegmina covering about three-fourths of abdomen, the vein separating

the dorsal field from the marginal, a yellowish white. The top of head and pronotum, and the surface of all the femora densely covered with brownish yellow hairs. Ovipositor a little shorter than hind femora, pale brown, the apical third darker, a little upcurved.

Measurements: Length of body, male, 10 mm., female, 11 mm.; of pronotum, male and female, 2.5 mm.; of tegmina, female, 7.5 mm.; of hind femora, male, 8 mm., female, 9 mm.; of ovipositor, 8 mm. Width of pronotum, 3.2 mm.

In Indiana this cricket has as yet been taken only in Vigo County, and during the month of September. The first ones discovered were on the slender twigs of some prickly-ash shrubs which grew in a damp upland woods. The place was visited a number of times and the crickets were always found, perfectly motionless, and immediately above or below one of the thorns or prickles jutting forth from the twigs. The tips of the hind femora were raised so as to project above the body, thus causing them to resemble the thorns; and the color of the insect, corresponding closely to that of the bark, made them very difficult to discover even when in especial search of them. On every clump of prickly-ash in the woods mentioned a number of specimens were secured, but they could be found nowhere else thereabouts. A second locality was about the roots of a scarlet oak, *Quercus coccinea* Wang, which grew on a sandy hillside. Here they were plentiful, and resting motionless in the depressions of the bark or beneath the leaves in the cavities formed by the roots of the tree. A pair were also noted in another place on the flowers of golden-rod.

Of all the males taken, over thirty in number, there was not one with perfect wing covers, and, in almost every instance, the wing covers as well as the rudimentary wings were wholly absent; while every female had both pairs unarmed. I at first ascribed this wing mutilation to the males fighting among themselves, but finally discovered a female in the act of devouring the wings of a male. Why this curious habit on the part of one sex? Possibly the females require a wing diet to requite them for their bestowed affections, or, perchance, they are a jealous set, and, having once gained the affections of a male, devour his wing covers to keep him from calling other females about him. *Quien sabe?*

It is more than probable, however, that the mating of the sexes takes place in a similar manner to that of the striped tree cricket (*Ecanthus fuscatus* Fitch, described above; the females gnawing away the tegmina of the males in order to more readily reach some seminal glands which lie beneath. The openings of these glands, located on the dorsum of the mesothorax, are visible in dried specimens at hand.

Agitator is said to be common in the middle and southeastern States, where it inhabits grapevines and dense shrubbery. The eggs of the female are there deposited in twigs of the white elm, *Ulmus americana* L., and the insects are very active at night, running and jumping about on the trunks of various trees.

LXIII. OROCHARIS Uhler (1864).

The members of this genus have the body flattened and rather slender: the head short, slightly narrower than the pronotum, the front depressed and prolonged between the eyes in the form of a short beak; ocelli present, arranged in a triangle on the short frontal beak; the maxillary palpi with the third segment longest, cylindrical; the apical one a little longer than the one preceding, enlarged gradually from the base, obliquely truncate. Pronotum wider than long, though narrower than the tegmina, the front and hind margins truncate and ciliate. Tegmina longer than the abdomen, their texture more membranous than in the preceding genus; strongly reticulated and tapering posteriorly; inner wings a little longer than the tegmina. Hind femora rather short and slender.

Three nominal species occur in the United States; of these one has been taken in Indiana.

148. OROCHARIS SALTATOR Uhler. The Jumping Tree Cricket.

Orocharis saltator Uhl., 212, II, 1864, 545; Riley, 113, I, 1869, 138; Id., 114, V, 1873, 119, Figs. 47, 48; Id., 121, VI, 1881, 62; Id., 122, II, 1884, 182, Fig. 258; Glov., 62, 1872, Plate III, Figs. 11, 12; Bl., 5, 1892, 138; Lugg., 84, 1898, 275, Fig. 186; Scudd., 188, 1900, 92.

Orocharis saltatrix Sauss., 132, VI, 1874, 494; Scudd., 174, XCIII, 1896, 694.

Apithes meneilli Bl., 5^a, XXIV, 1892, 27.

Palæ brownish yellow. A dark brown stripe reaches from the eye along the side of head and pronotum, and sometimes an irregular fuscous line on middle of pronotum. The tegmina each with a dark brown or fuscous spot at base, sometimes covering most of the wing; those of the female with many cross-veinlets which are darker than those running lengthwise, giving the dorsal field a checkered appearance; those of the male with the vein separating the dorsal field from the marginal, yellow. Inner wings extending 2 to 3 mm. beyond the tegmina. All the femora rather thickly marked with small, dark spots; those on the posterior pair being arranged in regular rows. Ovipositor a third longer than the hind femora, nearly straight.

Measurements: Length of body, male, 14 mm., female, 16 mm.; of pronotum, male and female, 2.5 mm.; of tegmina, male, 12.5 mm.,

female, 14 mm.; of hind femora, male, 8 mm., female, 10 mm.; of ovipositor, 12 mm.

This is a southern species, which in Indiana has so far been taken in small numbers only in Vigo, Putnam and Marion counties; though it doubtless occurs throughout the southern half of the State. In Vigo County it was found in October on the leaves of a golden-rod, *Solidago latifolia* L., and on those of prickly-ash, *Xanthoxylum americanum* Mill., both in dense upland woods. In Marion County, Philip

Baker brought me several specimens which he found on August 23d, beneath an old coat hanging on a grape arbor, in the back yard of his father's residence near the center of the city of Indianapolis. When disturbed it often seeks safety in flight, and when it alights flattens out its body close against its resting place. Professor Riley has given an interesting account of the egg-laying and song habits of the jumping tree cricket, from which I quote at length as follows:

"In December, 1877, I watched a female of *O. saltator* ovipositing in the end of a dead and rather soft twig of the soft maple at Kirkwood, Missouri. The twig had been pruned and the bark was somewhat gnawed by the cricket and the eggs thrust in irregularly from the end and from the sides. Both wood and pith were crammed with eggs, but all longitudinally inserted. The favorite nidus of the species is, however, the soft

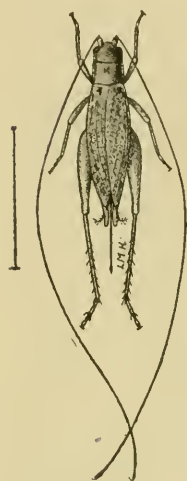


Fig. 122.
Orocharis saltator
Uhler. Female. (After
Lugger).

and somewhat corky, rough bark of the trunk and older branches of the American elm, the eggs being thrust in singly or in small batches, either longitudinally with, or very slightly obliquing from, the axis of trunk or branch. The female is very intent in the act, working her abdomen deliberately from side to side during the perforation.

"The stridulation of this cricket is a rather soft and musical piping of not quite half a second's duration, with from four to six trills, but so rapid that they are lost in the distance. The key is very high, but varies in different individuals and according to moisture and temperature. It most resembles the vibrating touch of the finger on the rim of an ordinary tumbler when three-fourths filled with water—repeated at intervals of from two to four per second, and it may be very well likened to the piping of a young chick and of some tree frogs. As the species is very common in the southwest its chirp is

everywhere heard and is so distinctive that when once studied it is never lost amid the louder racket of the katydids and other night choristers. It is frequently heard during the day time in cloudy or damp weather, and I have heard it at St. Louis the first days of November after a slight frost.

"The courting of the sexes is amusing. They face each other and play with their antennæ for the best part of an hour or more than an hour. The female is, otherwise, pretty quiet, but the male continually mouths the twig or the bark upon which the courting is being done, and plays his palpi at a great rate, very stealthily approaching nearer to his mate meanwhile. At last the antennal fencing ceases and those of the female bend back and then the male approaches until their heads touch. He then deliberately turns round, elevates the elytra and slips his abdomen under the female, who virtually mounts and assists him, his elytra overshadowing her head."

THE LIFE ZONES OF INDIANA, AS ILLUSTRATED BY THE DISTRIBUTION OF ORTHOPTERA WITHIN THE STATE.

The detailed study of the distribution of the Orthoptera of Indiana, made necessary in preparing the foregoing descriptive catalogue, has developed certain facts regarding the life zones of the State which are of especial interest. Dr. C. H. Merriam, in his "Life Zones and Crop Zones of the United States,"* has made the "Upper Austral" life zone cover the entire State, with the exception of a very small area of "Lower Austral" in the extreme southwestern corner. The facts brought out regarding the distribution of Orthoptera in Indiana, which are supplemented by numerous field notes on other groups of insect and animal life, and on the flowering plants, prove conclusively that the "Transition Zone," represented by the Alleghanian fauna and flora, overlaps the northern fourth of the State, while the "Lower Austral Zone," represented by the Austroriparian fauna and flora, covers the greater part of the southern third. The Carolinian fauna and flora of the Upper Austral embraces, of course, the prevailing forms of life in the State, 93 of the 148 species of the preceding catalogue belonging to it. The majority of these range over the entire State mingling with the representatives of the Alleghanian fauna in the north and with those of the Austroriparian fauna in the southern third. To the Carolinian fauna belongs also the great majority of the other forms of animal life in the State.

* Bulletin No. 10, Division Biological Survey, U. S. Department of Agriculture, 1898 pp. 1-79, map.

THE TRANSITION ZONE.—The three northern tiers of counties in Indiana embrace several hundred fresh water lakes within their bounds. These lakes range in size from an area of half an acre up to five and a half square miles. About their margins are often extensive areas of low, boggy land, covered with numerous forms of plant life whose main distribution is far to the north, and which have here their southern limit. Among the more characteristic plants of the Alleghanian flora, which are found only in the northern fourth of Indiana, are the following: Larch or tamarack, *Larix laricina* (Du Roi); arbor vitae or white cedar, *Thuja occidentalis* L.; false lily of the valley, *Unifolium canadense* (Desf.); moccasin flower, *Cypripedium acaule* Ait.; showy lady's slipper, *Cypripedium reginae* Walt.; bog orchis, *Arethusa bulbosa* L.; fen orchis, *Leptorchis laselii* (L.); sweet fern, *Comptonia peregrina* (L.); paper or canoe birch, *Betula papyrifera* Marsh.; speckled or hoary alder, *Alnus incana* (L.); gold-thread, *Coptis trifolia* (L.); round-leaved sundew, *Drosera rotundifolia* L.; black chokeberry, *Aronia nigra* (Willd.); round-leaved wintergreen, *Pyrola rotundifolia* L.; shin-leaf, *Pyrola elliptica* Nutt.; trailing arbutus, *Epigaea repens* L.; creeping wintergreen, *Gaultheria procumbens* L.; large cranberry, *Oxycoccus macrocarpus* (Air.); chick-weed wintergreen, *Trientalis americana* Pursh.; purple bladderwort, *Utricularia purpurea* Walt., and the twin-flower, *Linnaea borealis* L.

Among mammals and reptiles, the following representatives of the Alleghanian fauna occur in the northern fourth of the State: Canada porcupine, *Erethizon dorsatus* (L.); red squirrel or chickaree, *Sciurus hudsonicus* Erxleben; star-nosed mole, *Condylura cristata* (L.); hoary bat, *Atalapha cinerea* (Beauvais); American badger, *Taxidea americana* (Boddart); speckled tortoise, *Clemmys guttata* (Schneider), and Blanding's tortoise, *Emys melegris* Shaw.

Of the Orthoptera described in the foregoing catalogue, 23 species, or 15.5 per cent. of the total, may be classed as belonging to the Alleghanian fauna, and as occupying the southern limits of the Transition Zone, which lies between the Boreal and Upper Austral zones. These truly northern members of our Orthopteran fauna are as follows:

INDIANA ORTHOPTERA BELONGING TO THE ALLEGHANIAN FAUNA.

- | | |
|---|---|
| 1. <i>Ocephulella pelidna</i> (Burm.). | 6. <i>Hippiscus haldemanni</i> (Scudd.). |
| 2. <i>Ocephulella speciosa</i> (Scudd.). | 7. <i>Spharagemon wyomingianum</i> |
| 3. <i>Stenobothrus curtispennis</i> Harris. | (Thom.). |
| 4. <i>Mecostethus lineatus</i> (Scudd.). | 8. <i>Trimerotropis maritima</i> (Harris). |
| 5. <i>Cannula pellucida</i> (Scudd.). | 9. <i>Schistocerca rubiginosa</i> (Harris). |

- | | |
|--|---|
| 10. <i>Hesperotettix pratensis</i> Scudd. | 17. <i>Conocephalus robustus</i> Scudd. |
| 11. <i>Melanoplus fasciatus</i> (Walker). | 18. <i>Orchelimum indianense</i> Bl. |
| 12. <i>Melanoplus extremus</i> (Walker). | 19. <i>Orchelimum delicatum</i> Brun. |
| 13. <i>Melanoplus angustipennis</i> (Dodge). | 20. <i>Orchelimum gladiator</i> Brun. |
| 14. <i>Photallotes nebrascensis</i> (Thom.) | 21. <i>Nemobius palustris</i> Bl. |
| 15. <i>Paroryza scudderii</i> Bl. | 22. <i>Nemobius confusus</i> Bl. |
| 16. <i>Scudderia pistillata</i> Brunn. | 23. <i>Gryllus arenaceus</i> Bl. |

THE LOWER AUSTRAL ZONE.—The extreme northern boundary of the "Lower Austral" life zone passes in a northwest southeast direction through the following counties of Indiana: Vigo, Clay, Owen, Monroe, Jackson, Jennings, Jefferson and Switzerland. In the territory south of this line the Austroriparian fauna of that sub-zone overlaps and merges with the Carolinian fauna of the Upper Austral zone. The extension northward on the western line of the State is, without doubt, due to the presence of the broad and sheltering valley of the Wabash River, within the confines of which certain southern forms have found a climate mild and suitable to their habits. Within this valley the following members of the Austroriparian flora grow indigenously, a number of them as far north as Terre Haute: Bald cypress, *Taxodium distichum* (L.); upright burhead, *Echinodorus cordifolius* (L.); showy amaryllis, *Hymenocallis occidentalis* (Le Conte); pecan, *Hicoria pecan* (Marsh.); swamp or downy poplar, *Populus heterophylla* L.; chinquapin, *Castanea pumila* (L.); Texan red oak, *Quercus texana* Buckley; pipe vine, *Aristolochia tomentosa* Sims; American lotus, *Nelumbo lutea* (Willd.); Carolina moonseed, *Cebutha carolina* (L.); great burnet, *Sanguisorba canadensis* L.; water or swamp locust, *Gleditsia aquatica* Marsh; water ash, *Fraxinus caroliniana* Mill, and crossvine, *Bignonia crucigera* L.

Among other characteristic southern plant forms occurring in Indiana south of the northern boundary of the Lower Austral zone are: The yellow pine, *Pinus echinata* Mill.; mud plantain, *Heteranthera reniformis* R. & P.; false aloe, *Agave virginica* L.; Spanish oak, *Quercus digitata* (Marsh); southern hackberry, *Cellis mississippiensis* Bose.; American mistletoe, *Phoradendron flarescens* (Pursh.); cucumber tree, *Magnolia acuminata* L.; pencil flower, *Stylosanthes biflora* (L.); Carolina buckthorn, *Rhamnus caroliniana* Walt.; yellow passion flower, *Passiflora lutea* L.; Hercules club, *Aralia spinosa* L.; persimmon, *Diospyros virginiana* L.; unicorn plant, *Martynia louisiana* Mill.; catalpa, *Catalpa catalpa* (L.), and the rough button-weed, *Diodia teres* Walt.

The southern mockingbird, *Mimus polyglottos* (L.), nests in numbers as far north as Terre Haute; while among the batrachians and reptiles the hellbender, *Cryptobranchus alleghaniensis* (Daud.); the southern cricket frog, *Acris gryllus* Le Conte; the corn snake,

Ophibolus doliatus (L.); Say's chain snake, *Ophibolus calligaster* (Say); the bead snake, *Elaps fulvius* (L.); the ground lizard, *Oligosoma laterale* (Say); the alligator snapper, *Macrochelys lacertina* (Schweigger), and the yellow-bellied terrapin, *Pseudemys troosti* (Holbrook), all forms whose main distribution is far to the south, find in southern Indiana a congenial abiding place.

It is not strange, therefore, that we find, living with these plants and animals, a number of Orthoptera whose range has heretofore been thought to be confined to the region mapped by Merriam as the "Lower Austral." Thirty-two of the species listed in the preceding catalogue, or 21.6 per cent. of the total, may be classed as southern forms. They are as follows:

INDIANA ORTHOPTERA BELONGING TO THE AUSTRORIPARIAN FAUNA.

- | | |
|--|--|
| 1. <i>Tettigonyx deropeltiformis</i> Brunn. | 17. <i>Melanoplus morsei</i> Bl. |
| 2. <i>Ischnoptera unequalis</i> Sauss.-Zehnt. | 18. <i>Melanoplus impudicus</i> Scudd. |
| 3. <i>Ischnoptera major</i> (Sauss.-Zehnt.) | 19. <i>Amblycorypha uhleri</i> (Brunn.). |
| 4. <i>Stagmomantis carolina</i> (L.). | 20. <i>Conocephalus bruneri</i> Bl. |
| 5. <i>Gonatista grisea</i> (Fab.). | 21. <i>Atlantius dorsalis</i> (Burm.). |
| 6. <i>Anisomorpha ferruginea</i> (Pal. de Beauv.). | 22. <i>Camptonotus carolinensis</i> (Gers.). |
| 7. <i>Tettix arenosus</i> Burm. | 23. <i>Ceuthophilus stygius</i> (Scudd.). |
| 8. <i>Neotettix hancocki</i> Bl. | 24. <i>Ceuthophilus uhleri</i> Scudd. |
| 9. <i>Tettigidea spicata</i> Morse. | 25. <i>Myrmecophila pergandei</i> Brun. |
| 10. <i>Tettigidea lateralis</i> (Say). | 26. <i>Nemobius canus</i> Scudd. |
| 11. <i>Syrbula admirabilis</i> (Uhl.). | 27. <i>Nemobius cubensis</i> Sauss. |
| 12. <i>Hippiscus phoenicopterus</i> (Germar). | 28. <i>Gryllus firmus</i> Scudd. |
| 13. <i>Mestobregma cinctum</i> (Thom.). | 29. <i>Miogryllus saussurei</i> (Scudd.). |
| 14. <i>Trimerotropis citrina</i> Scudd. | 30. <i>Phylloscirtus pulehellus</i> (Uhl.). |
| 15. <i>Leptysma marginicollis</i> (Serv.). | 31. <i>Apithes agitator</i> Uhl. |
| 16. <i>Schistocerca dumifica</i> (Sauss.). | 32. <i>Orocharis saltator</i> Uhl. |

Of the species listed, *Stagmomantis carolina* (L.), *Camptonotus carolinensis* (Gers.), *Syrbula admirabilis* (Uhl.) and *Orocharis saltator* Uhl. have been taken in small numbers as far north as Marion County; all the others only south of the line mentioned as forming the northern border of the Lower Austral. It will be noted that this line corresponds approximately with the southern border of the glacial invasion of Indiana, and it is more than probable that the ancestors of many of these southern forms existed in southern Indiana in preglacial times, when the climate was much warmer than now. As Webster has recently pointed out*, it is also probable that some of these Orthoptera, as well as a number of those species inhabiting the entire State, advanced into the State from the south as fast as it was uncovered by the receding ice.

* "The Diffusion of Insects in North America." *Psyche*, X, 1903, pp. 47-58.

The members of the Alleghanian fauna entered the State, for the most part, from the north or northeast. A number of those which I have not classed as Alleghanian or Austroriparian, and which, therefore, are to be considered Carolinian, evidently came in from the west. Chief among these are *Ageneotettix scudderi* (Brun.), *Melanoplus blatchleyi* Scudd., *Conocephalus palustris* Bl., *Xiphidium saltans* Scudd., *Xiphidium strictum* Scudd., and *Orchelimum volantum* McN., all of which appear to be confined to the western half of the State.

GLOSSARY OF TERMS USED IN TEXT.

- Abbreviated*.—Shortened—not reaching the tip of abdomen when applied to tegmina and wings.
- Abdomen*.—Posterior part of body.
- Aborted*.—Imperfectly developed.
- Acuminate*.—Becoming gradually narrower; tapering to a point.
- Acutely*.—Sharp; sharply pointed.
- Adult*.—The imago or winged stage of an insect.
- Anal*.—Situated at or near the anus.
- Annulus, annulation, annulate*.—Ringed; furnished with ring-like bands.
- Antennae*.—The jointed organs of touch and smell, attached to the upper part of the face.
- Anterior, anteriorly*.—Near the head; situated more to the front.
- Anus*.—The posterior opening of the alimentary canal.
- Aper.*—The terminal portion of any organ or part of the body.
- Apical, apically*.—That part of any organ farthest from the body.
- Appressed*.—Pressed closely against; fitting closely to.
- Approximate*.—Near to; near together.
- Apterous*.—Wingless.
- Arboreal*.—Living on or among trees.
- Arcuate*.—Arched; bowed.
- Area, areola, areolate*.—Wing cells; cellules; the membranaceous spaces between the nervules.

Articulated.—Divided into distinct joints.

Auditory organ.—Ear; hearing organ.

Attinent.—Touching; coming in contact with.

Basal.—Next to the body.

Bifid.—Cleft; cloven in two.

Calcaria.—The spines or spurs at the apex of the tibia.

Carina, carinæ (pl.).—A keel or ridge.

Castaneous.—Chestnut brown; bright reddish brown.

Cerci.—The appendages issuing from the sides of the last abdominal segment.

Chitine.—The corneous substance of the skin of an insect.

Cimeter-shaped.—Like a short, curved oriental sword.

Cinereous.—Ash-colored; gray tinged with blackish.

Clavate.—Having a thickened, club-like extremity.

Clypeus.—A part of the head.

Concave.—When the surface gradually declines toward the center, which thus becomes the deepest.

Convex.—When the surface gradually rises toward the center, which thus becomes the highest.

Cordiform, cordate.—Heart-shaped.

Coriaceous.—Leather-like, tough and somewhat rigid.

Corneous.—A horny substance, resembling horn.

Costa.—Median carina of the face.

Costal.—The front margin of tegmina or wing.

Coxa.—The globular or oblong basal piece of the leg.

Crest.—A sharp ridge.

Cristate.—With a prominent longitudinal carina on its upper surface.

Declivent.—Sloping downward.

Decurved.—Bent downward.

Depressed.—Pressed downward; more or less flattened vertically.

Dentate.—Furnished with a tooth or teeth.

Denticulations.—With fine tooth-like notches.

Dilated.—Broadened; expanded.

Dimorphic.—Existing in two forms.

Disk.—The middle of a surface; the surface within the margins.

Distal.—Farthest distant, opposite of proximal.

Diurnal.—Active during the day.

Dorsal.—Pertaining to the upper surface.

Dorsum.—The upper surface or back of thorax, abdomen, etc.

Elongate.—More lengthened than usual.

Elytra.—The wing covers; the tegmina.

Emarginate, emargination.—Edged; notched; terminating in an acute notch at tip.

Ensiform.—Sword-shaped; sharp on both edges and tapering to a point.

Exserted.—Protruding so as to be visible.

Falcate.—Sickle-shaped; curved like a sickle.

Fastigium.—The extreme point of the front or vertex of the head.

Fauna.—The animals of a locality.

Femur, femora (pl.).—The thigh or thighs.

Ferruginous.—Rusty brown; brownish red with some yellow.

Filiform.—Slender, thread-like.

Fossorial.—Fit or used for digging or burrowing.

Forcola.—A cavity or small depression.

Front, frons.—The upper forward part of the head.

Frontal.—Relating to the front or face.

Fuliginous.—Sooty; dark brown.

Fulvous.—Tawny or light yellowish brown.

Furcula.—The processes of the last abdominal segment of the male.

Fuscous.—Dark brown.

Fusiform.—Spindle-shaped.

Gena.—Cheek.

Gibbous.—Protuberant; swollen.

Glabrous.—Smooth or polished, not hairy.

Glaucous.—Whitish-blue, inclining to gray.

Globose.—Like a ball.

Granulated.—Furnished with minute prominences like grains of sand.

Griseous.—Light gray (white and black).

Gula.—Throat, concave portion below the head.

Habitat.—The place or region which an insect inhabits.

Hemispherical.—Shaped like half a ball.

Hexagonal.—Six sided.

Hibernate.—To pass the winter in seclusion or sleep.

Host.—The individual furnishing food to a parasite.

Humeral.—Situated on or near a humerus or front corner of the thorax or wing cover.

Hyaline.—Transparent, with a greenish tinge.

Imago.—An adult or winged insect.

Immaculate.—Not marked; unspotted.

Integument.—Outer covering, skin.

Intercalary vein.—See p. 136.

Interspace.—Space between.

Interrupted.—Suddenly stopped or broken.

Labial palpus.—See p. 131.

Labium.—Lower lip.

Labrum.—Upper lip.

Lanceolate.—Lance-shaped.

Larva.—The second or worm-like stage of an insect.

Lateral lobes of the pronotum.—The deflexed portions that cover the sides of thorax.

Linear.—Very slender.

Longitudinal.—Lengthwise.

Luteous.—Unmixed yellow; color of clay.

Maculate.—Spotted, marked with spots.

Mandibles.—Hard and horny jaws.

Marginal.—Situated on or near the margin.

Median.—Occupying the middle.

Membrane, membranous.—A thin tissue; consisting of a thin tissue.

Mesonotum.—The upper or dorsal surface of the mesothorax.

Mesosternum.—The under surface of the mesothorax.

Mesothorax.—The middle part of the thorax, to which the wing covers and middle pair of legs are attached.

Metamorphosis.—Changes an insect undergoes before reaching maturity.

Metanotum.—The upper or dorsal surface of the metathorax.

Metathorax.—The posterior part of the thorax to which the wings and hind pair of legs are attached.

Metazona.—The posterior part of the pronotum.

Millimeter (mm).—The thousandth part of a meter, equal to 0.03937 inch, or nearly 1-25th inch.

Nebulous.—Clouded; with uneven, cloudy markings.

Nerves.—The large ribs or veins of wing and wing-covers, extending from the base toward the apex.

Nervules.—The smaller connecting veins of the wings and wing covers.

Nocturnal.—Active at night.

Nymph.—An immature insect, active and feeding in the larval and pupal stages.

Obconic.—Conical, with the vertex pointing downward.

Oblique.—Slanting; when applied to the face, denotes that it slopes under and backward toward the breast.

Oblong.—With the transverse diameter much shorter than the longitudinal.

Obscure.—Wanting or nearly so; indistinct.

Obtuse.—Blunt.

Ocellus, ocelli.—The three simple eyes.

Occiput.—The back part of the head.

Omnivorous.—Eating everything eatable.

Oötheca.—A case enclosing eggs.

Opaque.—Without any lustre; impenetrable by light rays.

Ovipositor.—The organ for depositing eggs.

Oviposition.—The act of laying eggs.

Pallid.—Pale or whitish yellow.

Palpus, palpi.—Articulated and movable organs attached to the maxillæ and mandibles.

Parasite.—An animal which grows and lives upon another.

Pellucid.—Transparent; translucent, but not necessarily colorless.

Pentagonal.—Five-sided.

Percurrent.—Running through the entire length.

Piceous.—Pitchy, the color of pitch.

Pilose.—Having long, sparse hairs.

Plantula.—A cushion-like pad between the tarsal hooks or ungues; same as *pulvillus*.

Plumbeous.—Pale, blue gray, like lead.

Pronotum.—The shield which covers the front part of the thorax.

Prosternum.—The under surface of the thorax.

Prosternal spine.—A spine projecting from the under side of the prothorax.

Prothorax.—The anterior division of the thorax to which the head is joined.

Proximal.—Nearest; opposite of distal.

Prozona.—The front dorsal part of the pronotum.

Pubescent.—Covered with soft, short and not crowded hair, wool or down.

Punctate, punctured.—Containing numerous small, point-like depressions or punctures.

Pupa, pupal.—The third stage of an insect; the stage before the imago.

Pulvillus, pulvilli.—The little pads between the claws of the tarsi.

Pyriform.—Pear-shaped.

Reticulate.—With net-like veins or markings.

Rudimentary.—Not sufficiently developed to be of use.

Rugose.—Rough, wrinkled; furnished with numerous small elevations.

Rufous.—Dark reddish brown.

Saltatorial.—Fitted for leaping.

Scabrous.—Covered with small, slight elevations; rough like a file.

Scrobes.—Pits or depressions in which are placed the bases of the antennæ.

Segment.—Ring-like division or joint, as of the antennæ.

Serrate.—Saw-toothed.

Serrations.—Teeth like a saw.

Serrulate.—Finely serrate; having minute serrations.

Selaccous.—Bristle-shaped.

Sinuate.—Winding in and out; twice or more curved.

Sinus.—An excavation as if scooped out.

Smooth.—Without elevations or wrinkles.

Solitary.—Single.

Spatulate.—Paddle or spoon-shaped; flattened and broader at the apex than at the base.

Spinose.—Armed with spines.

Spinulose.—Furnished with *spinules* or diminutive spines.

Spiracle.—An external opening of the respiratory system.

Spurs.—The strong spines at the apex of the tibiæ.

Sternite.—The ventral part of each abdominal segment.

Sternum.—The ventral part of a body segment.

Stridulate.—To make a shrill sound; to grate, scrape or creak with the stridulating organs.

Styliform.—Shaped like a style.

Sub.—A prefix meaning nearly; almost; somewhat; under, etc.

Sub-costal vein. See p. 135.

Sub-median vein. See p. 136.

Sulcate.—Grooved, furrowed.

Sulcus, sulci (pl.).—A linear groove or channel; a groove-like excavation.

Suture.—A seam or impressed line; generally used in reference to the junction of two pieces or plates.

Tarsus, tarsi (*tarsal*).—The jointed foot.

Tectiform.—Ridged in the middle and sloping down on each side.

Tegmina.—The fore wings, upper wings or wing covers.

Terete.—Sub-cylindrical; straight, without enlargements.

Tergite (tergum).—The dorsal part of a body segment.

Testaceous.—Dull yellowish brown; tile or brick colored.

Thorax.—The part of the body of an insect to which are fastened wings and legs.

Translucent.—Transmitting very little light.

Transparent.—Transmitting light.

Transverse.—Crosswise; signifies that the part or area is broader than it is long.

Tri-carinate.—Having three keels or carinae.

Trochanter.—The second joint of the leg.

Truncate.—Cut off squarely at the tip.

Tubercle.—A little solid pimple or excrescence.

Tuberculate.—Covered with tubercles.

Tympanum.—The membrane closing the ear.

Unarmed.—Without a spine.

Ungues.—The curved hooks terminating the tarsus.

Ulnar vein. See p. 136.

Valves.—Four horny appendages forming the ovipositor.

Veins.—Nerves; ribs of a wing.

Veinlets.—Nervules; very small cross-veins of the wings.

Venation.—Method of distribution of veins.

Ventral.—Pertaining to the under surface of the abdomen.

Vertex.—The front portion of the upper surface of the head between and in front of the eyes.

Wing-covers.—Front wings; tegmina.

Wing-pads.—Undeveloped wings, as in the pupa or nymph.

INDEX TO ORTHOPTERA OF INDIANA.

(FAMILY AND SUB-FAMILY NAMES ARE IN SMALL CAPITALS; GENERIC AND SPECIFIC NAMES IN ROMAN.)

	PAGE
Abdomen of locust	138
Acknowledgments	127
ACRIDIDÆ	210, 211
ACRIDINÆ	215, 285
Ageneotettix	234, 248
scudderii	248
Alleghanian fauna of Indiana, Orthoptera belonging to.....	462
Amblycorypha	343, 350
oblongifolia	350
rotundifolia	350, 352
uhleri	350, 353
Anatomy, external, of a locust.....	129
Anaxipha	454
exigua	455
ANISOMORPHINÆ	203, 207
Anisomorpha	208
ferruginea	208
Ant crickets	416
Austroriparian fauna of Indiana, Orthoptera belonging to.....	464
Apithes	457
agitator	457
Arphia	252, 254
sulphurea	255
xanthoptera	255, 256
Atlanticus	392
dorsalis	393, 394
pachymerus	393
Bibliography	148
Birds, Indiana, which feed upon Orthoptera, list of.....	147
BACUNCULINÆ	203, 204
Blatta	192
orientalis	192
Blattella	176, 187
germanica	187
BLATTIDÆ	167, 172
BLATTINÆ	174, 175

	PAGE
Camel crickets	396
black-sided	400
cave	401
spotted	399
Uhler's	404
Cammula	253, 261
pellucida	262
Camptonotus	395
carolinensis	396
Catalogue of Indiana Orthoptera	167
Centrophilus	397
blatchleyi	398, 403
brevipes	398, 406
latens	398, 400
maculatus	398, 399
stygius	398, 401
terrestris	398, 406
uhleri	398, 404
Chitin	129
Chilcaltis	234, 243
conspersa	243
Chorthopaga	253, 254
viridifasciata	258
Cockroaches	172
remedies for	189
Cockroach, American	195
German	187
Pennsylvania	179
oriental	192
CONOCEPHALINÆ	341, 362
Conocephalus	363
bruneri	364, 367
ensiger	364, 365
nebrascensis	364, 366
palustris	364, 369
robustus	364, 368
Cricket, field	429
ground	419
house	439
mole	410
sand	413
tree	443
Crickets	407
egg-laying habits of	408
stridulation of	407
Croton bug	187
Cyrtophyllus	358
perspicillatus	358

	PAGE
DECTICINÆ	342, 392
Diapheromera	204
femorata	204
Dicromorpha	234, 238
viridis	238
Dissosteira	253, 272
carolina	273
Earwigs	168
little	171
Ellipes	410, 415
minuta	415
Encoptolophus	253, 260
sordidus	260
ENEOPTERINÆ	409, 457
Faunas of Indiana	461
Alleghanian	462
Austroriparian	464
Carolinian	461
Field crickets	429
American	433
Pennsylvania	437
sand-loving	434
short-winged	435
Forficula	169
aculeata	169, 170
auricularia	169, 170
FORFICULIDÆ	167, 168
Fungus attacking locusts	142
Glossary	465
Gonatista	199, 201
grisea	202
Grasshoppers, black-legged	387
black-sided	376
common meadow	383
cone-headed	363
Bruner's	367
marsh	370
nebraska	366
robust	368
lance-tailed	379
shield-backed	393
short-winged meadow	373
slender meadow	372
sword bearer	365
Ground crickets	419
Carolina	427
marsh	427
spotted	424
striped	421

	PAGE
Grouse locusts	215
crested	218
granulated	224
Hancock's	223
hooded	227
obscure	225
ornate	222
GRYLLACINÆ	342, 395
GRYLLIDÆ	210, 407
GRYLLINÆ	409, 418
Gryllotalpa	410
borealis	411
GRYLLOTALPINÆ	409, 410
Gryllus	419, 429
abbreviatus	431, 435
americanus	431, 433
arenaceus	431, 434
domesticus	432, 439
firmus	431, 432
pennsylvanicus	432, 437
Head of a locust	130
Hesperotettix	287, 297
pratensis	297
Hippiscus	253, 263
haldemanni	264, 269
phaenicopterus	264, 267
rugosus	264, 270
tuberculatus	264, 265
House cricket	439
Illustrations	127
Indiana Orthoptera, Catalogue of	167
Iscnoptera	176, 178
inaequalis	178, 182
intricata	179, 186
major	178, 183
pennsylvanica	178, 179
uhleriana	179, 184
Katyids, egg-laying habits of	343, 345, 349, 355, 361
stridulation of	340, 342, 360
Katydid, broad-winged	358
curved-tailed	345
fork-tailed	348
larger angular-winged	354
oblong-leaf winged	350
pink	351
round winged	352
texas	344
true	358
Uhler's	353

	PAGE
Labia	169, 171
minor	171
Legs of a locust, parts of	137
Leptysma	286, 287
marginicollis	288
Life zones of Indiana	461
Austral, lower	461, 463
Austral, upper	461
Transition	461, 462
LOCUSTIDÆ	210, 340
Locust, American	290
ash brown	279
black-winged	273
Boll's	275
Carolina	273
clear-winged	262
clouded	260
common red-legged	317
coral-winged	265
graceful	308
green-legged	305
green-striped	258
grizzly	331
Haldeman's	268
handsome	236
hoosier	336
Kansas	300
leather-colored	294
lesser	314
long-horned	284
lubberly	270, 326
maritime	281
Morse's	309
mottled sand	277
narrow-winged	321
obovate-winged	306
orange-winged	267
Rocky mountain	300
rusty	296
Scudder's short-winged	302
short-horned	235
short-winged brown	246
short-winged green	238
slender bodied	288
smaller spotted-winged	240
sprinkled	243
sulphur-winged	255
yellow-striped	399
Locusts, egg-laying habits of	213
moulting of	140, 213
stridulation of	211, 252, 286

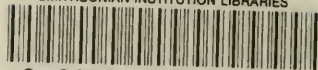
	PAGE
MANTIDÆ	167, 198
MANTINÆ	199
Mantis, Carolina	200
grizzled	202
Mecostethus	234, 249
lineatus	250
Melanoplus	287, 298
angustipennis	302, 321
atlanis	301, 314
bivittatus	302, 329
blatchleyi	301, 313
differentialis,	302, 326
extremus	302, 319
fasciatus	301, 311
femur-rubrum	301, 317
gracilis	301, 308
impudicus	301, 316
luridus	302, 324
minor	302, 322
morsei	301, 309
obovatipennis	300, 306
punctulatus	302, 331
scudderi	300, 302
spretus	300
viridipes	300, 305
Mestobregma	254, 279
cinctum	279
Microcentrum	343, 353
laurifolium	354
retinerve	354
Miogryllus	419, 442
saussurei	442
Mole cricket	410
Myrmecophila	416
pergandei	418
MYRMECOPHILINÆ	409, 415
Nemobius	419
canus	420, 423
carolinus	421, 427
confusus	421, 428
cubensis	420, 425
exiguus	420, 426
fasciatus	420, 421
maculatus	420, 424
palustris	421, 427
Neotettix	218, 226
hancocki	226
Nomotettix	217, 218
compressus	218
NON-SALTATORIA	167

	PAGE
ÆCANTHINÆ	409, 443
Æcanthus	444
angustipennis	444, 450
fasciatus	444, 450
latipennis	444, 445
niveus	444, 446
quadripunctatus	445, 452
ÆDIPODINÆ	212, 215, 251
Oötheca	173
Orchelimum	363, 381
campestre	382, 386
delicatum	382, 389
glaberrimum	382, 385
gladiator	382, 390
indianense	382, 388
nigripes	382, 387
volantum	382, 390
vulgare	382, 383
Orchesticus	392
Orocharis	457, 459
saltator	459
Orphulella	234, 239
pelidna	240
speciosa	240, 242
Orthoptera, enemies of	141
definition of	141
number of in Indiana	141
number of in the United States	141
Parasites of locusts, animal	143
vegetable	142
Paratettix	218, 227
cucullatus	227
Paroxya	287, 335
hoosieri	336
scudderi	338
Periplaneta	192, 195
americana	195
australasia	195, 197
PERIPLANETINÆ	175, 191
PHANEROPTERINÆ	341, 342
Phasmidæ	168, 203
Phætalotes	287, 334
nebrascensis	334
Phylloscirtus	454, 456
pulchellus	456
PSEUDOPHYLLINÆ	341, 358
Psinidia	254, 283
fenestralis	284

	PAGE
Roaches	172
SALTATORIA	167, 210
Sand crickets	413
Schistocerca	287, 289
alutacea	290, 294
americana	290
damnifica	290, 293
rubiginosa	290, 296
Scudderia	343
curvicauda	344, 345
furcata	344, 348
pistillata	344, 347
texensis	344
Spharagemon	253, 275
bolli	275
wyomingianum	275, 277
Stagmomantis	199
carolina	200
Stenobothrus	234, 246
curtipennis	246
STENOPELMATINÆ	342, 396
Syrbula	233, 236
admirabilis	236
Temnopteryx	176
deropeltiformis	177
Tettigidea	218, 228
armata	229
lateralis	229, 231
parvipennis	229, 230
spicata	229, 230
TETTIGINÆ	214, 215
Tettix	218, 219
arenosus	220, 224
granulatus	220
haucki	220, 223
obscurus	220, 225
ornatus	220, 222
Thorax and its appendages	133
Tree crickets	443
broad-winged	445
four-spotted	452
handsome	456
jumping	459
narrow-winged	450
snowy	446
striped	450
two-spotted	453
Tridactylus	410, 413
apicalis	414

TRIGONIDIINÆ	409, 454
Trimerotropis	254, 280
citrina	281, 282
maritima	281
TRYXALINÆ	215, 232
Tryxalis	233, 234
brevicornis	235
Veins of wings of a locust.....	135
Walkingsticks	203
lesser two-striped	208
thick-thighed	204
Wings of the locust	135
Xabea	444, 453
bipunctata	453
Xiphidium	363, 371
attenuatum	372, 379
brevipenne	372, 373
ensiferum	372, 375
fasciatum	371, 372
nemorale	372, 374
nigropleura	372, 376
saltans	372, 377
strictum	372, 378
Zones, life, of Indiana.....	461

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